OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

DCO Submission

Environmental Statement

Chapter 11: Ground Conditions

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Revision A

On behalf of
Oxfordshire Railfreight Limited

Prepared by BWB Consulting Ltd
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Glossary

Acronym	Definition
AFFF	Aqueous Film Forming Foam
AOD	Above Ordnance Datum
BGS	British Geological Survey
BSI	British Standards Institution
CDM	Construction (Design and Management) Regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment
CQA	Construction Quality Assurance
CSM	Conceptual Site Model
DoWCoP	Definition of Waste Code of Practice
DMRB	Design Manual for Roads and Bridges
DWS	Drinking Water Standard(s)
EQS	Environmental Quality Standard(s)
ERF	Energy Recovery Facility
FWRA	Foundation Works Risk Assessment
GIA	Gross Internal Area
GI	Ground Investigation
GWDTE	Groundwater Dependent Terrestrial Ecosystem
HAZID	Hazard Identification
HRA	Hydrogeological Risk Assessment
HSE	Health and Safety Executive
LCRM	Land Contamination Risk Management
MAGIC	Multi-Agency Geographic Information for the Countryside
MMP	Materials Management Plan
MSA	Mineral Safeguarding Area
PAH	Polycyclic Aromatic Hydrocarbon
P-CEMP	Phase Construction Environmental Management Plan
PFAS	Per- and Polyfluoroalkyl Substances(if incorporating the PFAS Technical Note)
PFHxS	Perfluorohexane Sulfonate
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PPE	Personal Protective Equipment
RAF	Royal Air Force
RIGS	Regionally Important Geological Site
SiLC	Specialist in Land Condition

SVOC	Semi-Volatile Organic Compound
UK	United Kingdom
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WCS	Water Cycle Study
WFD	Water Framework Directive
WHO	World Health Organisation

11.1 INTRODUCTION

11.1.1 This ES Chapter considers the likely significant environmental effects of the Proposed Development on the geology, soils and controlled waters beneath the Application Site and in the local area.

11.1.2 This chapter provides a description of the methods used in the assessment, followed by a description of the baseline conditions of the Application Site and surrounding area, and an assessment of the likely environmental effects of the Proposed Development during the construction works and during the operation of the Proposed Development. Mitigation measures are identified (where appropriate) to avoid, reduce or offset any significant adverse effects identified, together with the nature and significance of likely residual effects.

11.1.3 This Chapter includes an assessment of the potential likely significant effects of the Proposed Development alone and in combination with other surrounding committed developments using the information available.

Competency

11.1.4 In line with the 2017 EIA Regulations, this ES chapter has been compiled by appropriately qualified, experienced, and competent experts. The author of this chapter is Richard Robinson BSc (Hons) MCIWEM a Geo-Environmental Consultant (Associate Director) with 22 years of industry experience, in the UK. This chapter has been reviewed by Chris Rhodes BSc MSc FGS (16 years of relevant UK experience) and approved by Tim Hull BSc MSc CGeol FGS SiLC SQP (25 years of relevant UK experience).

11.2 ASSESSMENT SCOPE AND METHODOLOGY

11.2.1 This chapter assesses the likelihood of any existing contamination being present at the Application Site, such that it could cause significant environmental or health effects if not addressed adequately at the construction and/or operational stages. In addition, the construction will entail bringing materials onto the Application Site (such as fuel) which if spilt or leaked could result in land or groundwater contamination. Impairment and sterilisation of geological and mineral resources, and impacts to important geologically designated sites, will likewise be addressed.

11.2.2 A risk-based approach in accordance with Defra[1], and the Environment Agency (EA) guidance[2], has been taken to assess contamination which may have a significant effect upon the construction and operation of the Proposed Development, or upon the wider environment as a consequence of the Proposed Development.

11.2.3 Separate Phase 1 Geo-Environmental Assessment reports have been produced by Hydrock for the Main Site (**ES Appendix 11.1**) and Highways Works (**ES Appendix 11.2**). A Mineral Assessment Report (**ES Appendix 11.3**) has been completed by BWB Consulting covering the full Application Site. Preliminary ground investigation and assessment has been undertaken across the Main Site excluding Ardley Landfill (**ES Appendix 11.4**), Highway Works (**ES Appendix 11.5**) and Ardley Landfill (**ES Appendix 11.6**) to assess the preliminary Conceptual Site Model (CSM) derived in the desk studies. This suite of analysis and evidence informs an assessment of any potentially significant contaminant linkages associated with potential sources identified in the Hydrock Geo-Environmental desk studies. Further ground investigation is likely to also be required to confirm final design though this will be completed post submission once detailed development and infrastructure designs are at an advanced stage.

11.2.4 With regards to sites of geological interest, information has been obtained from Natural England, the British Geological Survey (BGS), Oxfordshire County Council (OCC) and Cherwell District Council (CDC) who hold information on such sites.

11.2.5 This Chapter and the appended reports and information provide details of the basic ground conditions at the Application Site, including information on the geology, minerals, ground conditions, the site's history, hydrogeology, and contamination. The assessment considers the results of the specific site investigation works and takes into consideration the CSM when assessing the potential impacts and effects of the Proposed Development. Where appropriate, this chapter proposes mitigation measures and considers the residual impacts following implementation of appropriate mitigation.

[1] Department for Environment, Farming and Rural Affairs; Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance; April 2012
[2] Environment Agency report Land Contamination Risk Management, 2020 (https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm) is the governments primary guidance on the assessment and management of the risks from land contamination

Consultation

EIA Scoping Opinion

11.2.6 An application for an EIA Scoping Opinion was submitted to the Secretary of State in June 2021. A Scoping Opinion from the Planning Inspectorate, on behalf of the Secretary of State, was provided in July 2021. Table 11.1 summarises the Planning Inspectorate's comments received in relation to the Ground Conditions, and how these comments have been considered in the ES chapter.

Table 11.1: Advice in the Secretary of State's EIA Scoping Opinion concerning the assessment of Ground Conditions (July 2021)

PINS ID	Subject	Comments	Response
4.9.1	Ground conditions for highways works	The Scoping Report indicates that ground investigations will not be carried out for the highway works as part of the ES. Given that the highways routes are yet to be confirmed for the Proposed Development and given there is limited information in the Scoping Report to understand the nature of the Proposed Development outside of the 'Main Site', the Inspectorate does not agree that this matter can be scoped out of assessment in the ES for highways works.	This ES chapter has assessed the whole of the Application Site including the highways works and not only the 'Main Site'. Ground investigations have also been completed for the highway works areas.
4.9.2	Cumulative effects	The Applicant proposes to scope out cumulative effects on ground conditions on the basis that the Scoping Report considers any effects would be localised. Given the stage of the project and the scale of the Proposed Development, however, the Inspectorate believes that there is insufficient evidence that cumulative effects on ground conditions will not occur. Potential cumulative effects on ground conditions should therefore be scoped into the assessment.	Cumulative effects have been included in this chapter.
4.9.3	Effects of the whole Proposed Development	The Scoping Report refers throughout the chapter to the scope of the assessment for the 'Main Site' and largely omits consideration of other elements of the Proposed Development. The Inspectorate considers that there is also potential for other significant effects to occur in these areas. The ES should therefore scope in effects relating to all of the areas of the Proposed Development.	Assessment of the full Order Limits is included in this ES Chapter.

4.9.4	Study area	The Scoping Report defines the study area for the ground conditions assessment as the application site and immediate surrounding area (within 250m of the boundary). Environment Agency guidance on the safe development of housing has been cited as the basis for the selection of the study area. The ES should justify any study areas used for the assessment and ensure that they are based on relevant and appropriate guidance for identifying the likely significant effects of all elements of the Proposed Development. Study areas should be established in conjunction with other relevant aspect assessments.	A radius of 250m is a general area within which all features will be considered in initial assessment. However, significant features beyond this are still taken into account such as sensitive aquifers, significant water courses, or particularly significant industries or contaminative uses that could affect the Applications Site / be affected by the Proposed Development.
	Statutory and non-statutory protected geodiversity sites	The Thames Valley Environmental Records Centre should be used as a source of data for local sites of geodiversity interest. The Ground Conditions assessment should scope in potential effects on any non–statutory protected geological sites (Local Geological Sites) where these are present and there is potential for significant effects to occur. The scope of the assessment should consider both direct and indirect effects on designated geodiversity sites and consult with the relevant local conservation groups and Natural England regarding any effects on such sites.	Environmental Records have been reviewed and identified both Ardley Trackways SSSI, and Ardley Cutting geological SSSI which have been included within this assessment and consultation.
4.9.5	Assessment and receptors	The Scoping Report considers workers on, and end-users of, the Proposed Development as the potential receptors for the assessment. The Inspectorate considers that the Ground Conditions assessment needs to include a wider scope of receptors than those related to risks to health. This should include for example, risks to controlled waters, surface waters and commercial or residential property.	The assessment has included all potential receptors associated with ground including human health, controlled waters, structures, geology, and soils.
4.9.6	Guidance documents	The ES should also consider guidance in relation to highways works and contamination, such as the Design Manual for Roads and Bridges (2019) Geology and Soils.	This is acknowledged and is included as guidance in the assessment.

Consultation with Statutory Bodies

Natural England

11.2.7 Exposed rock faces are present on each side of an operational railway cutting that runs along the north east edge of the Main Site, as well as a small exposure within Ardey Landfill, in the north east of the Main Site. These rock features are categorised as a geological SSSI by Natural England known as 'Ardley Cutting and Quarry SSSI'. Natural England has made the following comment relevant to this chapter:

> "*The SSSI is notified for its Geological Interest, specifically exposures of Jurassic Rocks which are of significant National importance. ES Chapter 11 Ground Conditions (11.5.12) describes the removal of small areas of rock as part of the works. Natural England encourages the submission of a strategy which sets out how the integrity of these features are to be maintained so that key sections of the stratigraphy are exposed or can be practically re exposed if required. The strategy may include works which could provide the opportunity to create new exposures in the rock face if possible. This will be particularly of note in regards to the south eastern most of the two unit 3 areas of the SSSI site, which appears to be potentially highly impacted by the proposals*."

11.2.8 Parts of the SSSI along the northern boundary of the Main Site will only be affected where new rail connections will be developed and will require existing rock faces to be excavated. The Unit 3 area mentioned (Zones A1a and B, and Areas A2 of the Parameters Plan) by Natural England is not within the designated SSSI and there is unlikely to be an opportunity to create rock faces in this area. However, the existing rock faces are within a railway cutting and not publicly accessible. Based on the Proposed Development, a mitigation strategy has been developed and included in this Chapter.

Environment Agency

11.2.9 The scheme includes the southern rail alignment for the Railfreight Terminal and part of Ardley Bypass going through what is currently the former Ardley Landfill, which is still a permitted landfill site. The Ground Investigation undertaken at the landfill to inform the Ground Chapter has been completed through formal agreements with the EA with a Construction Quality Assurance (CQA) plan and verification report having been submitted and approved.

11.2.10 The development at the Application Site will require alterations (reprofiling) to the Former Ardley Landfill and corresponding amendments to existing waste permitting. Agreement to the proposal has been obtained from the EA. This is covered in more detail in the Materials & Waste Chapter (Chapter 13).

11.2.11 The Draft ES (part of the Preliminary Environmental Information Report, PEIR) was submitted for the stage 2 consultation in September 2025 to the EA, Oxfordshire County Council (OCC) and Cherwell District Council (CDC). The feedback received which is relevant to this chapter and how this has been considered is provided in Tables 11.2 and 11.3 below.

Table 11.2: EA Consultation Feedback (November 2025)

Subject	Comments	Response
Groundwater in ES as a whole	Need to coordinate/be clear and consistent re: groundwater issues across Chapter 11 (Ground) and Chapter 9 (Water).	Groundwater forms part of the assessment provided within this Chapter.
Groundwater receptors	No reference to groundwater dependant terrestrial ecosystems (GWDTEs) and private water supplies have not been referenced in Chapters 9 and 11 which, according to their introductions consider risks to groundwater. Include private water supplies (if present) and groundwater dependant terrestrial ecosystems (GWDTEs) in future assessments.	Reference to possible GWDTE and private water supplies has been added to the baseline section (Paragraph 11.4.78.
Foundations (Piling)	No confirmation of the type of foundations which will be used for the buildings on site. Risk of polluting the underlying aquifer if piled foundations are used. If piled foundations are used, they could potentially act as pathways for the transfer of contaminants to the underlying Principal aquifer.	This was set out in the draft ES Chapter for the stage 2 consultation and stated that shallow foundations were expected to be suitable. However, while unlikely, if problem ground is encountered, or development with limited settlement tolerance is undertaken, a piled solution could be needed. Contingency (and additional mitigation) for this has been added as part of this assessment.
CEMP and Groundwater receptors	EA points re: CEMP and coverage/assessment of ES chapters (Chapter 11 - Ground). The EA is looking for more detail re: mitigation for groundwater effects?	The CEMP (ES Appendix 2.3) has been reviewed and updated in consideration of the comments made by the EA.
Earthworks and	Lack of clarity as to whether impacts on groundwater levels or groundwater	Further details have been added to the baseline information section,

groundwater receptors	receptors (e.g. private water supplies) have been considered at this stage. The risk of disturbing confining aquifer beds and encountering Artesian conditions beneath the site have not been mentioned. Risk of impacts to groundwater receptors from the removal of large quantities of material have not been considered. The Hydrogeological Risk Assessment discussed in paragraph 11.7.5 should consider private water supplies, the risk of disturbing confining aquifer beds and encountering Artesian conditions.	and impact assessment sections (See paragraphs 11.4.35 to 11.4.42, and (11.5.29).
Re-use of Excavated Material	Re-use of excavated material is proposed under CL:AIRE Definition of Waste Code of Practice (DoWCoP). However, this may not be possible for some of the excavated material, creating a risk of lack of compliance with waste management regulations. A Materials Management Plan (MMP) would be required.	A MMP is proposed as part of the CEMP (Section 15 of the CEMP (ES Appendix 2.3)). The potential constraint on the re-use of some material (e.g. material within the landfill) is understood – that is not proposed to be re-used within the wider site, but will be reprofiled within the landfill area itself (as agreed with the EA National Permitting Service).

Local Authorities

11.2.12 Feedback received from OCC and CDC which is relevant to this chapter, and how this has been considered, is summarised in Table 11.3 below. The Applicant team also met with the OCC as Minerals Authority to discuss the matters presented in the table below prior to preparing the final ES and supporting Minerals Resource Assessment (**ES Appendix 11.3**).

Table 11.3: OCC/CDC Consultation Feedback (November 2025)

Subject	Comments	Response
Policy M8 conformity	Concerns raised about conformity with Minerals Plan. Key paragraph: *8.10.11 While the consultation documents, particularly the Mineral Resource Assessment within the Environmental Statement, includes some information on development need, and estimations of mineral resources within the site, at this stage, we do not consider the assessments, analysis and conclusions within the Mineral Resource Assessment to accurately*	The Minerals Assessment (Appendix 11.3) has been updated to provide further details on the extent of resource and economic requirements of the scheme; these should be read alongside the economic needs of the Proposed

	reflect the potential impact on Oxfordshire's mineral resources. Neither does it currently demonstrate that the development need outweighs the value of the safeguarded resource.	Development which are detailed in Chapter 2.
Quality of Minerals Resource	*8.10.15 The Mineral Resource Assessment states that limestone is generally located 1m below the surface, with an average depth of 6m across the site. While the 1m depth is supported by the dataset, it is unclear how the 6m average has been derived, as the data indicates a range of depths between 5m and 10m. We request further clarification from the applicant on this point.* *8.10.16 Based on these given assumptions, the Mineral Resource Assessment estimates that the development would sterilise approximately 27.6 million tonnes of crushed rock, assuming 50% of the deposit is workable. However, no justification is provided as to why only 50% of the deposit has been assumed to be workable. If 75% were workable, the site could yield around 41.4 million tonnes; at 100%, up to 55 million tonnes.* *8.10.17 Even at the 50% assumption, the site contains significant reserves that could meet Oxfordshire's crushed rock requirements for at least 27 years, well beyond the current plan period to 2031.* *8.10.18 In light of this information we strongly disagree with the assessment of impact of the loss of this mineral resource as set out in Table 11.4 Summary of Likely Effects in Chapter 11 as minor, and the level of Effect as Minor Adverse. This is a large resource and so should reflect the criteria as set out in Table 11.2 – Sensitivity of Geological Receptors, and be classified as High Sensitivity. Nor do we agree with the Table 11.3 - Effect of the Magnitude Criteria, that only operational resources would be considered major. This site is on a Mineral Safeguarded Area as set out in the Oxfordshire Minerals and Waste Local Plan and the loss of an assumed 27 million tonnes, should be classed as Major.* *8.10.19 We therefore seek clarification on how both the depth and workability figures have been calculated. Once this information is provided, we will be able to fully assess the Mineral Resource Assessment and its impact on minerals within Oxfordshire. The Authority would also like*	The Minerals Assessment (**ES Appendix 11.3)** has been updated to provide further details on how volumes have been derived. There is a limestone resource beneath the site. The assessment of impact has been undertaken in accordance with the assessment methodology agreed as part of the EIA Scoping process (led by PINS) which states development which sterilises a minerals resource, which are not an existing or permitted minerals site is a Minor Impact. Notwithstanding the impact derived, mitigation has been outlined in accordance with the Minerals & Waste Core Strategy.

	additional time to explore undertaking their own Mineral Resource Assessment.	
Minerals Demand	Minerals Demand 8.10.20 As Minerals Planning Authority, we wish to highlight that the Mineral Resource Assessment and supporting documents contain several inaccurate and misleading statements regarding the need and demand for crushed rock in Oxfordshire, which must be addressed prior to submission.	Discussed this comment with OCC and updates made to the Minerals Assessment accordingly.
Ardley Trackway	OCC view is that: *it is clear that this significant and irreplicable geological and palaeontological asset extends well beyond northern boundary of the Ardley Trackway SSSI.* On this basis, OCC assume we are likely to have some impact (rail cutting). *8.10.23 The applicants proposed rail cutting, to connect their rail terminal into the existing Chiltern Main Line (which is in itself in a SSSI), lies to the north of Dewars Farm Quarry and so it is likely that the dinosaur footprints and other palaeontological assets could be present within the application site.* Also, further commentary – key points: *8.10.49 Given this, the councils believe there would be a greater adverse effect which would require mitigation. Palaeontology falls outside the scope of Oxfordshire County Archaeological Services expertise, however the councils consider that a reasonable approach would be to approach a credible palaeontological institute, such as the University of Oxford, and agree a methodology for a watching brief to be undertaken by the palaeontological institute. This watching brief should identify which excavations would need to be monitored based on the anticipated depth of their impact and the location in relation to the relevant limestone deposits. This watching brief would need to be secured via a requirement in the DCO.* *8.10.50 These footprints are a known asset which OCC has sought to mitigate and avoid impacts on when determining applications for minerals extraction within the locality. For instance, Condition 17 in recent permission*	Applicant has adopted the suggested approach of a watching brief during excavation of key geologies at the site. This has been included in mitigation set out in this ES Chapter, to be secured by requirement in the DCO.

	MW.0049/23 limits the excavation of minerals resources at Dewars Farm to the depth of the top of the relevant geological strata. This type of condition would not be possible in relation to the proposed development; however, it highlights that the likelihood of significant impacts on these assets has been deemed significantly high to warrant mitigation in the form of a condition. The Councils do not see that this should not be the case for the proposed development.	
Adequacy of ES and mitigation	Numerous points made under different sub-headings, with some repetition from the earlier sections. Includes concerns/questions re: national and local policy compliance: 8*.10.36 Furthermore, the NPPF (para. 223c) requires mineral safeguarding to ensure resources are protected for potential future use, even where there is no presumption that they will be worked. This site could not only meet demand today, but demand for future generations. Sterilising such a substantial mineral resource would conflict with the NPPF.* *8.10.37 No mitigation measures to safeguard the mineral resources have been put forward therefore the proposal is currently considered contrary to Paragraph 5.916[3] of the NNNPS.*	Mitigation is provided in the ES. However, updates have been made to better highlight the mitigation put forward. The approach taken accords with national policy.

General Approach and Data Sources

11.2.13 The general methodology for assessing effects followed a standard process and involved the following desk-based and intrusive elements :

- Review of local, regional and national planning strategies and development plan policies (including, but not limited to, land contamination, aquifer protection, mineral resources);
- Review of published documents, current standards, and current best practice guidance; and
- A site reconnaissance completed by Hydrock as part of their investigations and BWB to confirm desk-based information and identify and confirm the current state and use of the Application Site.

11.2.14 A review of the following reports and information sources has been undertaken to provide site specific factual data upon geology, soils and groundwater to

[3] It is understood this was intended to refer to NPS paragraph 5.196.

support the development of the baseline ground model and assessment of baseline conditions:

- Groundsure reports, reference GSIP-2021-10846-4671 and HMD-214-7439283 included within the Phase 1 Reports (**ES Appendix 11.1** and **ES Appendix 11.2**);
- 1:2,500 and 1:10,000 scale Historical Ordnance Survey Mapping;
- Historical aerial photographs (Google Earth) and other imagery (Groundsure Reports within **ES Appendix 11.1** and **ES Appendix 11.2**);
- BGS 1:50 000 Scale[4] geological mapping;
- BGS[5] online geological maps and exploratory hole records;
- MAGIC[6] website;
- Coal Authority (now Mining Remediation Authority) Interactive Map Viewer[7];
- Regional Unexploded Ordnance (UXO) risk maps[8];
- Main Site Area Factual Ground Investigation Report[9] (within **ES Appendix 11.4**);
- Highway Works Factual Ground Investigation Report[10]' (within **Appendix 11.5**);
- Ardley Landfill Ground Investigation Report[11]' (within **ES Appendix 11.6**); and
- First Line Defence UXO risk assessment (part of **ES Appendix 11.4**)[12].

11.2.15 The earthworks construction phase of the Proposed Development will comprise a phased enabling works package to prepare development platforms, comprising the stripping of topsoil and bulk earthworks using site won materials and provision of primary infrastructure. The submitted details

[4] BGS 1:50 000 Scale[4] , 'Buckingham', Sheet 219, Solid and Drift, (2002)
[5] BGS online geological maps and exploratory hole records www.bgs.ac.uk
[6] MAGIC website (www.natureonthemap.naturalengland.org.uk/magicmap)
[7] Coal Authority Interactive Map Viewer (https://datamine-cauk.hub.arcgis.com/)
[8] Regional Unexploded Ordnance (UXO) risk maps, (https://zeticauxo.com/downloads-and-resources/risk-maps/)
[9] Oxfordshire RFI Ardley, Oxon Factual Ground Investigation Report by Exploration & Testing Associates for BWB Consulting Ltd, reference C10172-FGIR-01, dated November 2021
[10] Oxfordshire RFI Ardley, Oxon Second Phase Investigation, Factual Ground Investigation Report by Exploration & Testing Associates for BWB Consulting Ltd, reference C10172-FGIR-01, dated November 2022
[11] Oxfordshire RFI Ardley, Oxon Second Phase Investigation, Factual Ground Investigation Report by Exploration & Testing Associates for BWB Consulting Ltd, reference C10172-FGIR-01, dated November 2022
[12] Detailed Unexploded Ordnance Risk Assessment, by 1st Line Defence for BWB Consulting Ltd, Upper Heyford, Oxfordshire, Ref. DA13850 dated 24th August 2021 – this forms an appendix to ES Appendix 11.4.

demonstrate how an earthworks balance can be achieved across all of the OxSRFI works. This assessment reflects one potential way to construct the earthworks following the Illustrative Masterplan. There is built in flexibility to amend the site levels and earthworks whilst maintaining accordance with the Parameters Plan and still delivering an earthworks balance. Construction of the Rail Terminal will commence, and buildings will follow in several phases. Current earthwork models (included with the Construction Environmental Management Plan (CEMP) at ES Appendix 2.3) indicate an estimated 3.8Mm^3 of cut and fill with up to 10.0m of earth to be cut from of the Main Site and re-engineered across the central and eastern extents to raise levels and create suitable development platforms. The greatest cut is near the west end of the Rail Terminal.

11.2.16 The key activities of the Operational Phase will comprise road and rail logistics, maintenance of vehicles and rail stock, and the storage and distribution of goods. Where necessary suitable mitigation options are detailed and their residual effect measured using updated and extended qualitative risk assessment matrices to demonstrate the effect, and post mitigation effects. Cumulative effects have been considered where other schemes are planned that might affect the same receptors.

Study Area

11.2.17 The extent of the Ground Conditions Study Area is the Application Site (Order Limits) itself and the immediate surrounding areas. The immediate surrounding area is defined for the purposes of the assessment as land within close proximity to or bordering the Application Site (i.e. within 250m from the Application Site boundary), which has the potential to be a contaminant source where there is a potential pathway for contaminant migration which may affect the Application Site or be affected by the Application Site.

11.2.18 The inclusion of a 250m buffer is based on the 'Guidance for the Safe Development of Housing on Land Affected by Contamination'[13]. This buffer is a conservative approach due to the lower sensitivity of commercial development relative to housing, but reasonable in the context of the Proposed Development considering the distance over which contamination can migrate, and the relatively low density of development near the scheme. However, significant features beyond this are still taken into account such as sensitive

[13] 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (Environment Agency, 2008)

aquifers, significant water courses, or particularly significant industries or contaminative uses that could affect the site or be affected by the site.

Identifying Risks

11.2.19 A preliminary risk assessment is included in this chapter in line with Land Contamination Risk Management[14], which includes a geo-environmental Hazard Identification ('HAZID'), which seeks to list all the suspected contaminant sources, the receptors that might be harmed by those sources and the pathways via which the sources might reach the receptors to cause the harm. The source-pathway-receptor concept is known as a contaminant linkage (formerly a pollutant linkage) and only when a linkage is complete is there any possibility of risk of harm arising. The source-pathway-receptor concept will be assessed through production of a 'CSM'. Each contaminant linkage is risk assessed in accordance with the risk assessment methodology set out in CIRIA C552 [15] presented as **ES Appendix 11.7**. Those risks assessed as moderate/minor or greater are considered to be potentially significant and so have been considered as potentially significant in the context of EIA.

11.2.20 Beneficial and adverse impacts have been identified, and options have been outlined for mitigating any potential adverse effects from the construction and operation in this chapter.

11.2.21 As well as the effects of contamination, other ground related issues / risks have been assessed, such as ground instability issues or other ground related development constraints (e.g. worked ground, mining), geologically sensitive sites, and loss of mineral resources.

Determining the significance of effects

11.2.22 The approach described in paragraphs 11.2.19 to 11.2.21 forms the basis of the methodology used in the assessment. For contamination to present a significant potential effect a link must first be established within the CSM. The likelihood must be demonstrated with an identifiable source (onsite or off site), a receptor and a viable pathway.

[14] Land Contamination Risk Management (https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm) is the governments primary guidance on the assessment and management of the risks from land contamination
[15] CIRIA C552 'Contaminated land risk assessment - a guide to good practice'.

11.2.23 The potential contamination sources have been identified from an assessment of current uses and activities on the Application Site, review of historical mapping for former uses and a review of regulatory permits, consents and authorisations contained within the Groundsure reports (within **ES Appendix 11.1** and **ES Appendix 11.2**) for potentially contaminative sites such as landfills, environmental permits, pollution controls.

11.2.24 Pathways identified are specific to the receptor type. For example, they could be:

- Ingestion, inhalation, dermal contact[16] for human health receptors;
- Infiltration and contaminant migration through permeable strata such as the unsaturated zone for groundwater;
- A secondary pathway from groundwater contamination to surface water;
- Migration of ground gases and vapours such as permanent gases, landfill gas and volatile hydrocarbons into buildings; and/or
- Direct contact and uptake by plants.

11.2.25 In this ES assessment, the probability is taken to be the degree of likelihood that one of the sensitive receptors suffers the impact. These are listed in Table 11.4.

Table 11.4 – Classification of Probability (after Rudland *et al.,* 2001)

Classification	Definition
High likelihood	There is a contaminant linkage, and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Medium likelihood	There is a contaminant linkage, and all elements are present and in the right place, which means that it is possible that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Negligible	There is a contaminant linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

[16] In a contaminated land assessment, dermal contact is the exposure pathway whereby a person comes into direct physical contact with contaminated soil, groundwater, surface water, dust, sediment, or other affected materials through their skin.

11.2.26 The sensitivity of geological receptors where the Proposed Development has the potential to destroy or deplete the amenity value, such as mineral resources or sites of geological interest, is judged according to the criteria in Table 11.5.

Table 11.5 – Sensitivity of Geological Receptors

Classification	Geological Sites	Mineral Resources
High sensitivity	High quality and rarity on regional or national or international scale. Protected by international or EU legislation (e.g. World Heritage).	Nationally important mineral. Large resource.
Medium sensitivity	High quality and rarity on national or local scale (e.g. SSSI).	Medium resource.
Low sensitivity	Medium quality and rarity on a local scale (e.g. Local Geological Site / RIGS).	Small resource.
Negligible	Little or no geological interest.	No mineral resource.

11.2.27 The magnitude of land contamination effects has been assessed by comparing all contaminant linkages at a baseline value (existing condition) to those during construction and operational circumstances. This provides a way of assessing adverse effects through the project lifecycle. The magnitude is assessed using a four-point scale as shown in Table 11.6.

Table 11.6: Effect Magnitude Criteria

Impact Type	Major	Moderate	Minor	Negligible
Human health impacts from chemicals in the ground.	Short-term (acute) effects likely to result in significant harm e.g. high concentration of cyanide on the surface of an informal recreational area.	Long-term (chronic) effects likely to result in significant harm e.g. high concentration of contaminants close to the surface of a development site.	Harm but probably not significant harm unless particularly sensitive individual within the receptor group. May be aesthetic/ olfactory impacts.	No measurable effects.
New planting impacts from chemicals in the ground.	Complete and rapid die-back of landscaped areas.	Stressed or dead plants in landscaped areas.	Damage to plants in landscaped areas, e.g. stunted growth, discoloration.	No measurable effects.

Impact Type	Major	Moderate	Minor	Negligible
Controlled Waters impacts from chemicals in the ground.	Short-term pollution, e.g. major spillage into controlled water. Substances leaching from contaminated soil cause receiving waters to exceed surface water and groundwater quality indicators (EQS/DWS) over a large area.	Pollution of sensitive water resources, e.g. leaching into Principal or Secondary aquifers or rivers. Substances leaching from contaminated soil cause receiving waters to exceed surface water and groundwater quality indicators (EQS/DWS) in limited areas.	Pollution of non-sensitive water bodies e.g. leaching into non-classified groundwater or minor ditches. Substances leaching from contaminated soil cause receiving waters to slightly exceed surface water and groundwater quality indicators (EQS/DWS) (based on professional judgement).	No measurable effects. Substances leaching from contaminated soil do not cause receiving waters to exceed surface water and groundwater quality indicators (EQS/DWS).
Ecosystems impacts from chemicals in the ground.	Short-term risk to a particular ecosystem or organism forming part of that ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of international significance (e.g. Ramsar site).	Death of species in a particular ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of national significance (e.g. Site of Special Scientific Interest).	Minor change in a particular ecosystem in a designated protected area, but not significant harm. Damage to a locally important area.	No measurable effects. Plausible contaminant linkage but no important or protected area.

Impact Type	Major	Moderate	Minor	Negligible
Site workers impacts from contaminants in the ground.	Risk assessment required to determine required personal protective equipment (PPE) and this may involve high level of protection similar to USEPA Level A, B or C.	Risk assessment required to determine required personal protective equipment (PPE) and this may involve high level of protection similar to USEPA Level B, C or D.	Risk assessment required to determine required personal protective equipment (PPE) and this may involve moderate level of protection similar to USEPA Level C or D.	No measurable effects, but simple personal protective equipment (PPE) required (similar to USEPA Level D protection, i.e. overalls, boots, goggles, hard hat).
Buildings etc. impacts from flammable ground gas.	Catastrophic damage, e.g. gas explosion causing collapse.	Damage renders unsafe to occupy.	Damage to sensitive buildings etc.	No measurable effects.
Damage to building products from chemicals in the ground (e.g. sulphate attack of concrete, organic solvent decay of plastics).	Maximum soil concentration exceeds industry accepted trigger value for DS5 conditions over a large area.	Maximum soil concentration exceeds industry accepted trigger value for DS5 conditions in limited areas or DS3 conditions over wider areas.	Maximum soil concentration exceeds industry accepted trigger value of DS3 conditions in limited areas or DS2 conditions over wider areas.	Maximum soil concentration less than industry accepted trigger value for DS2 conditions.
Human health impact from ground gases. Such as radon and landfill gas where exceedance of a risk-based trigger indicates the potential for harm.	Contaminant linkage identified over a large area.	Contaminant linkage identified in limited areas.	Contaminant linkage uncertain.	Plausible contaminant linkage not established.

Impact Type	Major	Moderate	Minor	Negligible
Impacts to people, property or infrastructure cause by excessive ground movements.	Major damage involving destruction of buildings or infrastructure, blocking of river courses and major flooding or loss of life.	Significant damage to property or infrastructure, minor damage to river channels, injury to people.	Minor damage to property or infrastructure, minor blocking of river channels.	Minor ground movements but no significant damage to property, infrastructure, river channels or human health.
Impacts to Geological SSSI	Damage to a protected area of international significance (e.g. Ramsar site).	Damage to a protected area of national significance (e.g. Site of Special Scientific Interest).	Damage to a locally important area.	No measurable effects. Plausible contaminant linkage but no important or protected area.
Impacts to viable mineral resource	Loss of resource at an operational minerals site, or approved extension of an operational mineral site.	Loss of mineral resource on land allocated in the Minerals and Waste Core Plan.	Loss of potential resource in a Mineral Resource Area.	No loss of resource.

11.2.28 The assessment of significance is based on the magnitude of the effect and the importance or sensitivity of the receptors as set out below in Table 11.7. The significance of the potential effects is identified, as well as those of the residual effects for geological and mineral effects. Appropriate mitigation measures will be recommended to reduce/control any significant adverse effects on sensitive receptors. Should significant effects associated with sources of contamination be identified, once remediated, there should be no significant residual effects with respect to land contamination issues.

Table 11.7: Significance of Effect Matrix

		Sensitivity			
		High Likelihood	**Medium Likelihood**	**Low Likelihood**	**Unlikely**
Magnitude	**Major**	Major significance	Major significance	Moderate significance	Minor significance
	Moderate	Major significance	Moderate significance	Minor significance	Negligible significance
	Minor	Moderate significance	Minor significance	Minor significance	Negligible significance
	Negligible	Minor significance	Negligible significance	Negligible significance	Negligible significance

11.2.29 Effects have the potential to be adverse, beneficial and temporary or permanent. For example, in terms of beneficial effects, the Proposed Development may remove a source of contamination, or it may break a pathway that currently links a source to a receptor. The effects criteria are presented in Table 11.8 below. The duration of the effect is also considered.

- Long-term: 15 years onwards for the life of the Proposed Development;
- Medium-term: 6 to 14 years; and
- Short-term: 0 to 5 years including the construction period and on completion.

11.2.30 Effects of moderate or greater significance are considered to be significant in terms of the EIA. Where effects are considered as marginal, i.e. moderate/minor a precautionary approach will be adopted when identifying mitigation requirements, and the effect taken to be significant.

Table 11.8: Significance Effect Criteria

Significance	Description
Major adverse	Short term (acute) risk to human health likely to result in “significant harm” as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings/ property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem.
Moderate adverse	Chronic damage to Human Health (“significant harm”). Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such ecosystem.
Minor adverse	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.

Significance	Description
Neutral	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by measures such as protective clothing etc.). Easily repairable effects of damage to buildings, structures and services.
Slight beneficial	Minor reduction in risk (slight, short or highly localised effect)
Moderate beneficial	Moderate reduction in risk, Improvement in water quality
Major beneficial	Major reduction in risk

Limitations and Assumptions

11.2.31 As with all ground investigation, a targeted approach has been undertaken to assess prevailing ground conditions and the contamination status of the Application Site. However, it is possible previously unforeseen sources of contamination could be identified during the development process. Contingency measures for dealing with such contamination will be included within a Remediation Strategy / Remediation Design Statement for the site, which will be prepared post-DCO, and secured by an appropriate DCO Requirement.

11.2.32 The Proposed Development includes the removal of the In Vessel Composting facility. To relinquish the existing waste treatment license for the existing facility a targeted ground investigation will be required in due course to establish whether the facility has impacted ground conditions, and if so, remediation would be necessary.

11.3 POLICY CONTEXT

National Policy

11.3.1 The applicable legislative framework for Contaminated Land is set out in Part 2A of the Environment Act 1990[17] and associated statutory guidance, while the National Policy Statement for National Networks (NPS) 2024[18] also refers to policy associated with contaminated land.

[17] Environment Act 1990
[18] National Policy Statement for National Networks (NPS) 204, Presented to Parliament pursuant to Section 9(8) and Section 5(4) of the Planning Act 2008, December 2014 - updated in March 2024.

11.3.2 The National Planning Policy Framework (NPPF) (2026)[19] sets out the Government's planning policies for England. It makes the following reference to Contaminated Land and ground conditions in the section entitled pollution, public protection and security.

11.3.3 Relevant text extracts of the above National Policies are included in **ES Appendix 11.8**.

11.3.4 Non statutory Guidance on Management of Contaminated Land (Land Contamination Risk Management) is issued by the Environment Agency.

Local Policies and Relevant Guidance

11.3.5 Assessment of the impact of the Proposed Development will also be undertaken in accordance with, but not limited to, the below policies:

- Adopted Cherwell Local Plan 2011-2031 (Part 1) adopted by the Council on 20 July 2015. Policy Bicester 13 was re-adopted on 19 December 2016;
- Cherwell District Council Water Cycle Study (WCS) published in November 2017 and its addendum;
- Oxfordshire Minerals and Waste Local Plan adopted on 12th September 2017.

11.3.6 Relevant text extracts of the above Local Policies are included in **ES Appendix 11.8**. There is a new draft Minerals and Waste Local Plan undergoing consultation, and an emerging new CDC Local Plan, but these have not been
Examined or adopted at the time of writing so not considered in this ES.

Construction (Design & Management) Regulations

11.3.7 The Construction (Design & Management) (CDM) Regulations[20] make explicit duties that exist under the Health and Safety at Work Act[21] and the Management of Health and Safety at Work Regulations[22]. This requires clients to use their influence to ensure that the arrangements made by other duty

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf
[19]The National Planning Policy Framework (NPPF) (2026)
[20] Construction (Design & Management) (CDM) Regulations (2015)
[21] Health and Safety at Work Act (1974)
[22] Management of Health and Safety at Work Regulations (1999)

holders are sufficient to safeguard the health and safety of those working or those affected by that work.

Other Guidance

11.3.8 Alongside the policies and guidance listed above, there is a range of non-statutory guidance material and British Standards which, where relevant, have been taken into account in this assessment, including:

- British Standards Institution (BSI): BS 10175:2011+A2:2017, (2017), Investigation of Potentially Contaminated Sites, Code of Practice;
- British Standards Institution (BSI): BS 5930:2015+A1:2020, (2020), Code of Practice for Ground Investigations;
- British Standards Institution (BSI): BS 8485:2015+A1:2019, (2019), Code of Practice for the Characterization and Remediation from Ground Gas in Affected Developments;
- British Standards Institution (BSI): BS 8576:2013, (2013), Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (VOCs);
- British Standards Institution (BSI): BS EN 1997-1:2004, (2004), Eurocode 7: Geotechnical Design – Part 1: General Rules;
- British Standards Institution (BSI): BS EN 1997-2:2007, (2007), Eurocode 7 Geotechnical Design – Part 2: Ground Investigation and Testing;
- Environment Agency Report, Land Contamination Risk Management (2020);
- Construction Industry Research and Information Association (CIRIA) Report C665, (2007), Assessing Risk Posed by Hazardous Ground Gases to Buildings;
- Construction Industry Research and Information Association (CIRIA) Report C741, (2015), Environmental Good Practice on Site 4th Edition;
- Construction Industry Research and Information Association (CIRIA) Report CIRIA C681, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry.'
- Contaminated Land: Applications in Real Environments (CL:AIRE) Definition Toxicological Assessment of Contaminants in Soil;
- Environment Agency Science Report SC050021/SR3, (2009), Updated Technical Background to the CLEA Model, 2009;
- Environment Agency Science Report SC050021/SR4, (2009), CLEA Software (Version 1.06) Handbook;
- Environment Agency, The Environment Agency's approach to groundwater protection February 2018 Version 1.2; and

- CD 622 Managing Geotechnical Risk, National Highways (formerly Highways England), Design Manual for Roads and Bridges (DMRB), March 2020 (Revision 1).

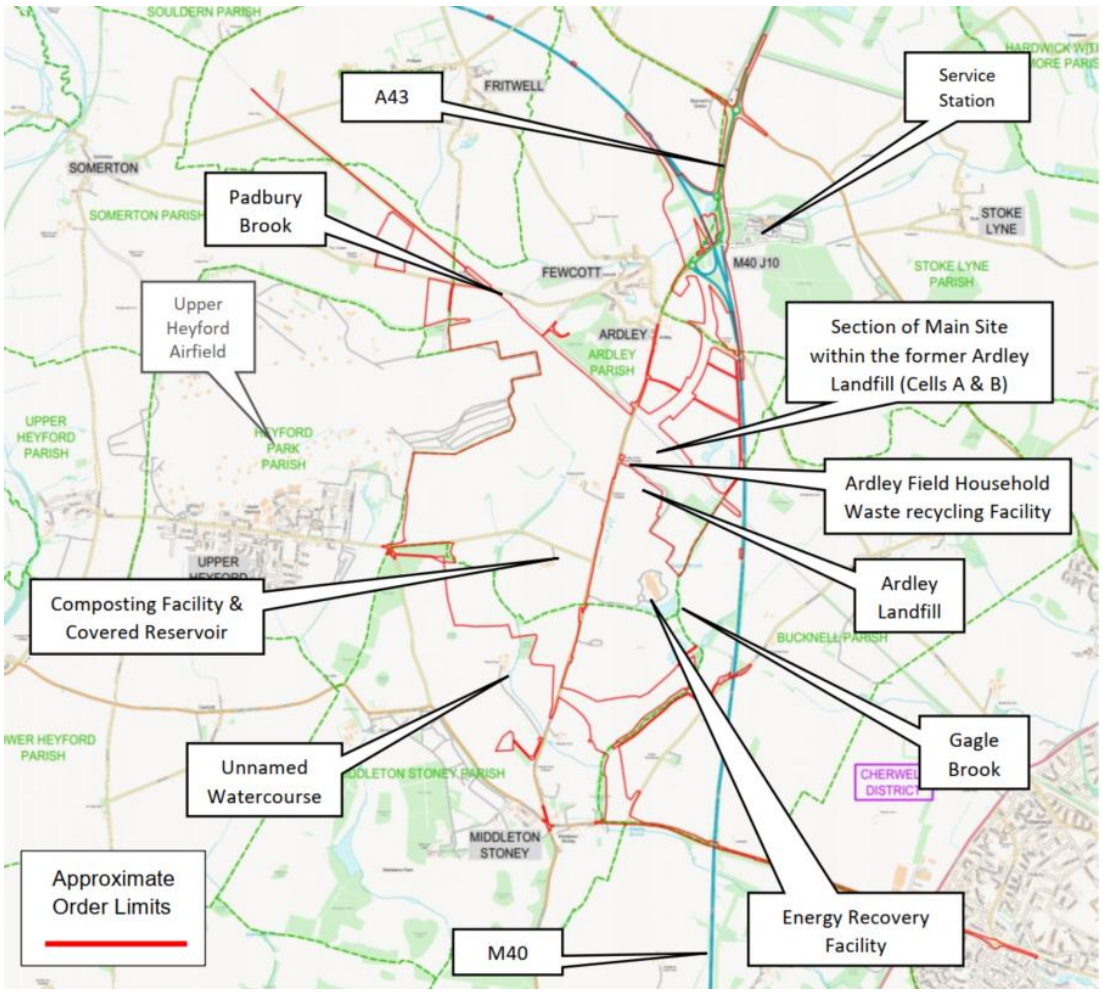
11.4 BASELINE CONDITIONS

11.4.1 Baseline Conditions are summarised in this section based on the desk studies and Ground Investigations completed (**ES Appendix 11.1 to 11.6**) covering the Study Area including the whole Application Site area.

Application Site Description

11.4.2 A detailed site description is included as Chapter 2 and so is not repeated here. However, a summary of the key features relevant to this chapter are highlighted. The key features (sources, pathways and/or receptors) have been identified on site from mapping and site walkover visits. The key features within the Application Site are presented on **ES Figure 11:1** and discussed overleaf.

Figure 11:1: Key Features Plan



Main Site Area

11.4.3 The Main Site area comprises open agricultural fields including Ashgrove Farm. Bordering pertinent features include the Chiltern Main Line rail to the northeast and the former Upper Heyford airbase to the west and northwest, and extending further south of Camp Road towards parcels of land near to Manor Farm. The area gently slopes from an elevation of 115m to 105m AOD from north to south, and it includes an unnamed watercourse which is a tributary to the Gagle Brook which flows north to south. Hedgerows and watercourses with wooded banks separate field parcels. Ashgrove Farm cottages and buildings are present within the east of the Main Site. To the south of Camp Road, two adjacent fenced compounds are occupied by the IVC Facility and a covered Thames Water Reservoir. Contamination sources are limited to those associated with agricultural use including farm machinery, pesticides, and herbicides.

11.4.4 The north east corner of the Main Site falls within the demise of Ardley Landfill, a 1980s landfill site which infilled a former quarry. Adjacent to this and bordering the site is an operational household, commercial and industrial Waste Transfer Station. This is a household waste recycling facility comprising waste disposal into skips / containers. The licensed waste accepted includes household, commercial and industrial waste.

11.4.5 Ardley Landfill is regulated under an Environmental Permit issued and enforced by the Environment Agency. The landfill is subject to ongoing compliance monitoring and management requirements, including controls relating to landfill gas, leachate generation, groundwater protection and environmental emissions. Existing control measures and monitoring demonstrate that the facility operates within an established regulatory framework designed to protect human health and the environment. The environmental permit regime provides an independent mechanism for the continued assessment and management of landfill-related risks throughout operation, restoration and aftercare. The landfill has an established hydrogeological risk assessment which supports the operation of the existing permitted landfill under an attenuation and dispersion scenario.

11.4.6 Approximately 400m east of the Main Site within the southern portion of the Ardley Landfill site is the operational ERF[23] (Viridor) for the incineration of waste. Wastes accepted include household, commercial and industrial waste, with the site dating from 2014. An active biological treatment facility (Ardley Leachate Treatment Plant) is also located at Viridor ERF.

Highway Works

11.4.7 The proposed Highway Works (including The J10 Highway Improvements Works, the Ardley Bypass and Principal Access, the Middleton Stoney Relief Road, Heyford Park Link and Secondary Access) mainly comprises of agricultural land, field boundaries and verges of existing road corridors. There are also two balancing ponds adjacent to J10.

11.4.8 Contamination sources were generally limited to those associated with agricultural use including farm machinery, and possible pesticides, and herbicides.

Application Site History

[23] Energy Recovery Facility

Main Site

11.4.9 Historically, the Main Site has been predominately agricultural land with Ashgrove Farm present since the earliest available mapping (1870s) and several smaller farm buildings in the west. By the late 1910s, Great Western Railway (now Chiltern Railway Line) was constructed, aligned southeast to northwest to the east of Upper Heyford Airfield (a former RAF base, see below) which is located to the immediate west of the Application Site.

11.4.10 The former Upper Heyford Airfield operated from the First World War and was subsequently used as a strategic bomber base, an RAF training facility and, between 1951 and 1994, a USAF airbase. These historical military and aviation activities have the potential to have resulted in ground and groundwater contamination, including from the storage, handling and distribution of fuels and oils and the potential use of firefighting foams. By the 1980s, several storage tanks and associated features were shown on the historical mapping reviewed in the vicinity of the airfield. The identification of these features on the mapping does not indicate that potentially contaminative activities commenced only during that decade.

11.4.11 An electrical substation was constructed opposite Ashgrove Farm, and a caravan park in the west of the Main Site. From the late 1980s, a water tower was present towards the south of the Main Site, later replaced as the present-day water pumping station, along with a covered reservoir. No significant changes take place with the Main Site until the early 2010s when a composting facility was constructed adjacent to the covered reservoir.

11.4.12 Historical military activities at the former RAF Upper Heyford Airfield are also recognised as a potential source of PFAS contamination associated with the historic use of aqueous film-forming firefighting foams (AFFF). Subsequent PFAS investigations (referred to later in this Chapter) have identified evidence consistent with contaminant migration from the former airfield via local surface water and groundwater pathways.

11.4.13 Waste licensing records indicate that the compositing facility has been present and operational since 2007. As referred to above, the north east area of the Main Site falls within Cells A and B of the former Ardley landfill. Ardley Landfill was licensed for inert, non-hazardous, stable non-reactive hazardous waste (in the form of asbestos) and hazardous waste from 1979 to 2014. The southern extension was operated as a co-disposal landfill from July 2000.

11.4.14 Ardley Quarry is shown to the east of the B430 (beyond Ardley Fields Farm) from the late 1890s, which had expanded southwards by the 1980s encroaching into the northern Ardley bypass road and Rail Corridor (north and south of the Chiltern Railway Line). Limestone extraction continued at Ardley Quarry until the late 1990s and was progressively backfilled as Ardley Landfill; the northern part of the former quarry was labelled as a refuse tip from the early 2000s. The northern portion of the quarry had been infilled by 2010, with the majority of Ardley Quarry infilled by 2019.

11.4.15 An historical landfill (Ardley Wood) was licensed for inert, industrial, commercial, household, and liquid sludge. The site is dated from 1940 to 1980, and is located north of the proposed highway works on the northern side of the railway line (north off Main Site)

Highway Works

11.4.16 To the north of the M40 the crossroads between the A43(T) crossing north to south with the A41(T) evolved during the mapping period from 1875 to the present day until being replaced by Baynard Roundabout by 1981. Grove Farm structures and Baynard House were shown 10m west of the current roundabout. Early mapping shows old quarries present 50m west and 50m southwest of Sycamore Grove which were no longer present by 1974. Diversion of Stoke Lyne Brook took place between 1974 and 1981. M40 had been constructed to the west of A43(T) by 1992, with Cherwell Valley Services shown on 2010 maps. A petrol station and associated services was present to the northwest of the Baynard Roundabout by 2004.

11.4.17 In the area to the north of the Chiltern Railway Line and between M40 and B430, three agricultural fields were shown to be excavated and potentially quarried between 2004 and 2010. Operations appear to have ceased by 2013 with some areas restored and others forming large ponds and surface water features.

Remaining Study Area Outside of Application Site

11.4.18 Historically, relevant features off site from the Application Site but within the wider Study Area relate to several farms and barns to the south and east of the Application Site and several small quarries to the north, east and northwest of the Application Site from the mid-1870s. By 1919, most quarries were listed as old or disused. The Upper Heyford Airfield (to the west of the Application Site) was used as a former RAF grass aerodrome in World War I which was not labelled on historical mapping (understood to be for national security

reasons) until the 1950s; the airfield was shown to expand to adjacent the northwest boundary of the area subject to ground investigation in Main Site by the 1980s. The majority of former quarries were no longer shown from the mid-1960s. Ardley Wood Quarry was shown to the north of the Chiltern Railway Line from the early-1980s and appears to have been infilled by the early 2000s; it is noted that the quarry was operational from the late 1800s and was mined more extensively in the late 1970s and early 1980s. Ardley / Dewars Farm Quarry is shown from 2013 to the south of Ardley Quarry and the Viridor Ardley Energy Recovery Facility (ERF) in which the ERF was under construction to the east of the Main Site in 2013. By the late 2010s, the ERF was constructed. By 2020, Ardley / Dewars Farm quarry had been extended south and remains active, with the north-western part appearing to be in the process of restoration.

11.4.19 The Upper Heyford Airfield was sold in 1994 and is in the process of being redeveloped as a mixed residential and commercial development known as 'Heyford Park'.

11.4.20 The area southeast of the B430 Heyford Park Link Road – Middleton Stoney Relief Road, underwent little modification during the mapping history, apart from the construction of the B430, the construction to the access of Ardley Quarry to the north of the proposed Middleton Stoney Relief Road and the expansion of the adjacent quarry.

Application Site Ground Conditions

Published Ground Conditions

11.4.21 Information published by the BGS has mapped Made Ground[24] in the north east of the Main Site and to the east of the Main Site confirming that landfilling has occurred (Ardley Landfill). In addition, several areas of Artificial Ground[25] are indicated immediately to the northwest (airfield, railway cutting and Ardley Wood), north (M40 and service station) and east of the Application Site (Ardley

[24]Made Ground defined as anthropogenic (man made) ground in which the material has been placed without engineering control and/or manufactured by man in some way, such as through crushing or washing, or arising from an industrial process.
[25] Artificially modified ground is an area where the pre-existing (natural) land surface or geological succession is modified by anthropogenic processes of material removal or deposition and may include made ground, worked ground, disturbed ground, landscaped ground and infilled ground.

/ Fields Farm Quarry and Ardley Landfill). All other areas are indicated to be absent of Artificial Ground or Made Ground.

11.4.22 The BGS mapping data indicates that superficial deposit[26] units are predominately absent across the Application Site and isolated pockets of Head[27] Deposits are indicated in the north of the Highway Works (A43 / M40 interchange) and in the northwest and north-central areas of the Main Site. Alluvium deposits are indicated along stream courses running through the centre of the Main Site trending north to south and in the northwest corner of the Main Site and in the northwest and north-central areas of the Main Site.

11.4.23 BGS mapping indicates that the Application Site is predominantly underlain by White Limestone Formation (comprising limestone, wackestone, packstone, grainstone and mudstone), with superficial deposits generally absent. A geological fault is shown to transect the north and northwest corner of the Application Site, trending west to northeast and downthrown to the north.

11.4.24 The Application Site is also interspersed with smaller areas of Rutland Formation (comprising mudstone, siltstone, and sandstone), and Forest Marble Formation Limestone (comprising mudstone, limestone, and sandstone) in the northwest of the Main Site.

11.4.25 The BGS mapping notes that the White Limestone Formation is subdivided into the Blandon Member (clay/mudstone), the Ardley Member (limestone, wackestone, packstone and mudstone) and the Shipton Member (limestone, wackestone, packstone and mudstone). Based on local BGS records, and because the White Limestone is expected to thin out towards the north west of the site where the Rutland Formation is indicated as the surface geology, the Blandon Member is likely absent across the site.

Ground Conditions Encountered: Main Site and Highway Works

[26] Superficial deposits refer to geological deposits typically of Quaternary age. These geologically recent unconsolidated sediments may include stream channel and floodplain deposits, beach sands, talus gravels and glacial drift and moraine. All pre-Quaternary deposits are referred to as bedrock.
[27] Head is poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. Solifluction is the slow viscous downslope flow of waterlogged soil and other unsorted and unsaturated superficial deposits. The term gelifluction is restricted to the slow flow of fluidized superficial deposits during the thawing of seasonally frozen ground. The flow is initiated by meltwater from thawing ice lenses. Polymict deposit: comprises gravel, sand and clay depending on upslope source and distance from source. Locally with lenses of silt, clay or peat and organic material.

11.4.26 Ground investigation works completed by Hydrock on Ashgrove Farm (BRD, 2015) and on the Main Site by BWB in September 2021 (**ES Appendix 11.4**) generally confirmed the anticipated geological sequences typically recording varying thickness of topsoil and subsoil (up to 1.0m thick) over slightly clayey to clayey sandy limestone recovered as a gravel. Limited Made Ground was recorded around the Ashgrove Farm area.

11.4.27 Alluvium was encountered in two locations, to the north and southwest of Ashgrove Farm. The deposits were recorded as a soft to firm clayey silt or silty clay.

11.4.28 The White Limestone Formation was encountered across the Main Site at proven thicknesses ranging between 0.26m and 9.80m, recovered as a very dense, greyish/orangish brown slightly clayey sandy gravel and gravelly sand, with gravels of limestone and some shell fragments and calcareous concretions. Interbedded layers of very dense grey slightly sandy gravel of limestone and orange, brown clayey sand was encountered towards the southeast of the Application site. A mudstone or siltstone layer (top of the Shipton Member of the White Limestone Formation); was recorded over Interbedded siltstone, mudrock and limestone (Shipton Member of the White Limestone).

11.4.29 Rutland Formation was encountered at one location to the southwest of Ashgrove Farm at a lower elevation in the river valley from 2.4m to 3.03m below ground level (bgl). The geology comprised firm greenish grey slightly silty, sandy, slightly gravelly clay with occasional shell fragments and gravels of limestone.

Ground Conditions Encountered: Ardley Landfill

11.4.30 Ground investigation works completed by BWB in November to December 2022 (**ES Appendix 11.6**) found topsoil over Made Ground comprising a clay capping layer (up to 2m bgl) of gravelly clay above the landfill deposits. Made Ground was encountered within all exploratory holes, under the capping layer and can broadly be distinguished in two separate strata. The upper layer contained cohesive soils with some organic material. The lower layer contained domestic waste with a small quantity of gravelly clay. White Limestone Formation was present below Made Ground with borehole terminated shortly after encountering the limestone to avoid presenting cross-contamination issues and in accordance with the agreement with the EA. In some exploratory holes near the surface, thin layers of laminated sandy clay

were found near the north west and north east boundaries and grey clayey sandy gravels were also noted on the north east site boundary.

Hydrogeology and Hydrology

Aquifer Designation

11.4.31 The groundwater body beneath the majority of the Application Site is the Tackley Jurassic aquifer and is classified as Good Chemical and Quantitative status under the Water Framework Directive (EEA, 2021) for the latest available year (2019). The Upper Bedford Ouse Oolite Principal 1 groundwater body is present beneath the far northern portion of the Application Site and is classified as Good Chemical and Quantitative status for the same year.

11.4.32 The ground conditions have been classified by the EA as follows:

11.4.33 Superficial Deposits:

- Alluvium: Secondary (A) Aquifer; and
- Head Deposit: Secondary Undifferentiated Aquifer.

11.4.34 Bedrock:

- White Limestone Formation: Principal Aquifer;
- Forest Marble Formation: Principal Aquifer; and
- Rutland Formation: Secondary (B) Aquifer.

11.4.35 The Application Site is not located within, or near, an EA designated groundwater Source Protection Zone.

Groundwater Abstractions

11.4.36 No active licensed or private groundwater abstractions have been identified on the Application Site or in the Study Area.

Hydrogeological Conditions Encountered: Main Site

11.4.37 Groundwater monitoring confirmed that two groundwater bodies are present at the Main Site; limited quantities of perched groundwater were present within shallow deposits, while the second Principal Aquifer is within the deeper limestone deposits.

11.4.38 During the 2021 ground investigation (**ES Appendix 11.4**), limited to the Main Site area, minor shallow groundwater strikes during excavation and drilling were encountered at depths between 1.3m and 2.0m bgl in only two locations within the perched aquifer. Water strikes were generally noted to be confined, with stratum of cohesive material identified above and below the water strike. Post-ground investigation monitoring recorded perched groundwater levels at depths ranging between 0.35m bgl and 1.43m bgl equivalent to elevations ranging between 106.42m AOD and 107.77m AOD. This is considered to be reflective of perched water contained within cohesive upper layers of the weathered White Limestone Formation, and not reflective of a continuous body of groundwater in the Study Area.

11.4.39 Ground investigations on the Main Site (**ES Appendix 11.4**) reported groundwater in the White Limestone Formation at depths of between 3.4 and 3.7m bgl. Two groundwater bodies were expected at the base of each of the limestone geologies, with the less permeable mudstone/siltstones/clays acting as an aquitard[28] between the shallower and deeper groundwater bodies. No artesian conditions were recorded during the ground investigation and are not expected given the high permeabilities, flow mechanisms and groundwater levels recorded.

11.4.40 Resting groundwater levels in the White Limestone Principal Aquifer were measured at depths ranging between 2.62m bgl and 5.9m bgl. equivalent to elevations ranging between 93.68m AOD and 115.1m AOD. The inferred groundwater flow direction at the Main Site is indicated to be in a south easterly direction with a gradient of approximately 1 in 60 which corresponds with the flow direction recorded at the adjacent Ardley Landfill, and generally with the hydrological flow direction of the local water courses.

11.4.41 No groundwater was encountered in the trial pits excavated along the Highway Works corridors (**ES Appendix 11.5**).

11.4.42 Groundwater flow through the White Limestone is predominantly migration through cracks and fissures which can create high flow rates. The White Limestone has thin bands of marl contained within, which are likely to create minor perched layers of groundwater. However, the main groundwater body is expected to rest over mudstone of the Rutland Formation which will create an

[28] An aquitard is a geological layer that has low hydraulic conductivity (permeability) and therefore transmits groundwater only very slowly. It can store water, but it significantly restricts the movement of groundwater between adjacent aquifers.

underlying confining layer. Information provided by personnel at the adjacent quarry indicates that in the circa 7-9m deep excavation they only deal within minor influx of groundwater which is readily dealt with using standard (sump and pump) dewatering.

Leachate Conditions Encountered – Ardley Landfill

11.4.43 All water strikes encountered in the Ardley Landfill Area were determined to be leachate from the landfill material and not groundwater in continuity with underlying and surrounding aquifers. During the ground investigation (**ES Appendix 11.6**) leachate strikes were encountered in all cable percussive boreholes and five dynamic sampling boreholes from depths of 1.0 to 10.3m bgl. Post-ground investigation monitoring recorded leachate levels between 1.58 to 6.86m bgl in nine boreholes. This data was used to produce an inferred leachate flow plot which determined that leachate may typically flow to the east through the landfill material.

Surface Water Features

11.4.44 Several surface watercourses are present in, and in the vicinity of, the Application Site which are presented below:

Table 11.9: Surface Water Features

Surface Water Feature	Location (Site Area)	Location (Flow)
Gagle Brook The proposed Middleton Stoney Relief Road will cross the brook, and it runs along the eastern edge of Ardley Landfill.	Generally, to the east of the Application Site but crosses the Application Site boundary in the southeast (**southeast on site**) flowing to the southeast.	Overall, hydraulically downgradient
Padbury Brook Classified as 'Fail' Chemical and Moderate Ecological status under the Water Framework Directive for the latest available data (2019 and 2022 respectively). It is noted to be heavily modified.	In the very northwest of the Main Site and north of the Application Site crossing the M40 to the north of J10 (**north onsite**) flowing to the east	Hydraulically upgradient except the northwest area of the Main site where it will be down gradient of the Railfreight Interchange.
M40 J10 balancing ponds Two balancing ponds are located between the M40 (west) and the A43 (east).	North of the Application Site (**north on site**)	Hydraulically upgradient
Covered Reservoir Appears to have been constructed in the 1980s. Reservoir to be retained as part of	Centre west of the Application Site (**central onsite**)	There is no continuity with this feature.

Surface Water Feature	Location (Site Area)	Location (Flow)
proposed development.		
Unnamed watercourses Two issues located central onsite which join the Gagle Brook offsite in the south[29]. The proposed link to Heyford Park via Camp Road will cross this watercourse.	Centre of the Application Site (**central on site**) flowing southeast	Hydraulically down/ cross-gradient
Gallos Brook (& Leys Farms Ditch) Classified as 'Good' Chemical and Moderate Ecological status under the Water Framework Directive for the latest available year (2019).	200m west of the Application Site (**west off site**) flowing south	Hydraulically upgradient

11.4.45 Several small drains and ponds and historic springs are also located towards the south of the Application Site, generally tributary water features to the unnamed water course that flows south into Gagle Brook. There are no active licensed surface water abstractions on or within 1km of the Application Site. There are four active licensed surface water discharges within 1km of the Application Site which all discharge into Leys Farm Ditch for either trade discharge (site drainage) or sewage discharge (final/treated effluent).

11.4.46 The Application Site falls within the Oxon Ray WFD catchment which is part of the Thames regional catchment, except the very northern part of the SRFI which falls into Great Ouse Upper WFD catchment, part of the Anglian Regional catchment.

11.4.47 The EA considers the majority of the Application Site to be at low risk of flooding (less than 1 in 1000 (0.1%)) from rivers and the sea, with no noted flood defences or flood water storage areas in the vicinity of the Application Site. However, small parts of the Application Site (in the north and south) are in Flood Zone 2 and 3 in the location of the streams (Padbury Brook, Gagle Brook and Unnamed watercourses). Hydrology and flood risk is assessed in Chapter 9.

Hazardous Ground Gas Assessment

Sources

[29] One of these tributaries has been referred to as the Ashgrove Brook in ES Chapter 9 (Water Environment)

11.4.48 Based on the desk study, the following potential sources of hazardous ground gas have been identified:

- Very localised Made Ground across the Application Site;
- Ardley Landfill to the east of B430 (northern extent onsite encroaching Main Site (rail) and Highway Works - Ardley Bypass);
- Natural organic material associated with Alluvium has potential for low level gas generating, although this is considered to be limited; and
- Ardley Wood Landfill approximately 10m north of the Main Site, beyond the railway cutting (north).

Ground Gas: Ardley Landfill

11.4.49 Ground gas monitoring was undertaken following ground investigation within the Application Site at Ardley Landfill (**ES Appendix 11.6**). The gas data shows that high gas and flow rates are present on site, with high levels of both carbon dioxide and methane recorded. However, no buildings are proposed on or in the immediate vicinity of the landfill. Maximum gas screening levels indicate that a gas regime of CS6 (Characteristic Situation 6) i.e. 'Very High' in accordance with BS8485:2015+A1:2019[30]. A gas extraction system is already in place at Ardley Landfill, although it is understood that it only functions intermittently due to low volumes of gas being produced. The wider Ardley landfill site to the south is understood to also have an active gas extraction system in place.

Ground Gas: Main Site

11.4.50 The majority of the Application Site has a very low gas generation potential. BWB has undertaken six gas monitoring visits over a six-month period between September 2021 and March 2022. Based on the data, the gas regime is assessed as CS1 (Characteristic Situation 1), i.e., 'Very Low Risk', in accordance with BS8485:2015+A1:2019 across the Main Site, for which no gas protection is required.

11.4.51 The gas data indicates no shallow ground gas risk in the east of the site adjacent to Ardley Landfill. However, the finished floor levels of the buildings in this area (Development Zone 1a, 1b, and 2) will be approximately 3.0m below existing ground levels and so the main gas risk will be via gas migration

[30]BS8485:2015+A1:2019: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

through fracturing in the deeper limestone. In addition, it is understood that active ground gas management is installed at Ardley Landfill which is likely to restrict potential for gas migration onto the Application Site. On this basis it has been recommended that Units within the eastern portion of the Main Site incorporate gas protection measures to CS2 level.

Ground Gas: Remaining Areas of the Application Site

11.4.52 Structures are not proposed across remaining areas of the site and limited sources of ground gas have been identified. A significant contaminant linkage has therefore not been identified.

Radon Gas at the Application Site

11.4.53 Sections of the Application Site in the far north and south are in Radon Affected Areas (radon levels in 1-3% of homes are above the action level), although the majority of the Main Site is not in a Radon Affected Area. Radon protection measures are not required for new buildings on the Main Site.

Contamination Assessment

11.4.54 The Hydrock Phase 1 Assessments (**ES Appendix 11.1** and **ES Appendix 11.2**) included a preliminary environmental risk assessment to identify potentially significant contaminant linkages. Based on the contaminant linkages identified, BWB designed and implemented a ground investigation to facilitate a generic quantitative risk assessment of the linkages. These assessments are detailed in a Phase 2 ground investigation for the Main Site (**ES Appendix 11.4**), Off-site Highways (**ES Appendix 11.5**) and Ardley Landfill (**ES Appendix 11.6**). The results of the assessments are summarised below.

11.4.55 Geo-environmental assessments have focused on areas where development, construction activity or ground disturbance are proposed. Certain areas of the Order Limits included for access, monitoring or permit-related purposes are not subject to substantive development and have therefore not been the focus of intrusive investigation.

Main Site

11.4.56 The 2021 ground investigation on the Main Site area (**ES Appendix 11.4**) did not record significant contamination of soil, groundwater or surface waters, including from the electrical substation or former/current fuel and oil storage at

Ashgrove Farm. Access could not be gained at the composting facility and covered reservoir; however, it is unlikely that significant contamination is present based on the uses at those sites.

11.4.57 Further targeted ground investigations and geotechnical assessments may be undertaken during detailed design where required to support engineering design. Any previously unidentified contamination encountered during these investigations or subsequent construction activities would be managed in accordance with the remediation and unexpected contamination procedures.

11.4.58 Made Ground was limited to two locations in the vicinity of Ashgrove Farm up to 1.3m bgl, with no significant contamination recorded. No Made Ground was recorded in the northeast of the site in the location of the former Ardley Landfill.

11.4.59 Groundwater and surface water contamination data have been compared to assessment criteria where the primary receptor is considered to be the underlying Principal Aquifer. The criteria includes reference to UK Drinking Water Standards (DWS), Guidelines for Drinking Water Quality (EQS Freshwater) and WHO health standards (WHO).

11.4.60 No groundwater and surface water samples contained contaminants at concentrations that exceeded the relevant screening criteria.

Per- and Polyfluoroalkyl Substances (PFAS)

11.4.61 Subsequent to completion of the Phase 2 Geo-Environmental Assessments, additional targeted sampling of surface water, sediment and groundwater was undertaken during June and September 2026 to assess the potential presence of per- and polyfluoroalkyl substances (PFAS) within the Main Site. PFAS are a group of persistent synthetic compounds associated with a variety of industrial and commercial uses, including historic use in firefighting foams.

11.4.62 The investigation identified detectable concentrations of PFAS within surface water, sediment and at a limited number of groundwater locations across the Main Site. The compounds detected predominantly comprised PFOS and PFHxS within surface waters, with PFHxS, PFNA and PFOA additionally detected in sediment samples. Groundwater testing identified trace concentrations of PFHxS, PFOA and PFOS in three of eleven monitoring locations.

11.4.63 The analytical results indicate that PFAS concentrations present within the Application Site are relatively low and substantially lower than concentrations

identified within data in the public domain relating to the Gallos Brook and associated tributaries located south of the former RAF Upper Heyford Airfield. The evidence indicates that the Main Site is acting primarily as a receptor and conveyance pathway for PFAS impacted water originating from off-site sources rather than being a source of PFAS contamination itself.

11.4.64 Full details of the sampling programme, results and assessment are provided within ES Appendix 11.11: OxSRFI PFAS Technical Note.

Ardley Landfill

11.4.65 The 2023 ground investigation on the Ardley Landfill site (**ES Appendix 11.6**) identified only two significant soil contaminant concentrations, with a maximum recorded concentration of 4,100 mg/kg. Concentrations of the other soil contaminants analysed were below the generic commercial soil screening criteria adopted for the assessment. These screening criteria relate principally to potential human-health risks and do not, in isolation, determine risks to controlled waters.

11.4.66 Leachate and water samples collected from installations completed within the landfill material were compared with relevant water-quality screening criteria as an initial conservative assessment of potential risks to controlled waters. These included UK drinking-water standards and relevant environmental quality standards. The comparison is intended as a screening exercise only, because the samples are representative of leachate and water within the landfill waste rather than groundwater within the underlying White Limestone Principal Aquifer.

11.4.67 The analysis identified elevated concentrations of ammonia, certain metals, polycyclic aromatic hydrocarbons and trace volatile organic compounds within leachate in the landfill material. The available monitoring data indicate a general easterly hydraulic gradient within the landfill. These results characterise the potential landfill source term but do not, in isolation, demonstrate the concentrations that may occur within the underlying aquifer.

11.4.68 Analysis of samples collected from monitoring installations completed within the landfill material identified elevated concentrations of contaminants including copper, nickel, sulphate and boron. A number of other contaminants, including chromium, ammonia, phenols, benzene, petroleum hydrocarbons and individual polycyclic aromatic hydrocarbons, were also reported in one or more samples. The occurrence and distribution of these substances vary

between the soil leachate and monitoring-installation results and are likely to reflect the heterogeneous composition of the landfill material and leachate.

11.4.69 The samples were obtained from installations completed within the landfill material and are not representative of groundwater quality within the underlying White Limestone Principal Aquifer. The results should therefore be interpreted as characterising the landfill source term rather than demonstrating groundwater quality beneath the landfill.

11.4.70 Ardley Landfill is regulated under an EA Environmental Permit supported by an approved Hydrogeological Risk Assessment. The permitted hydrogeological conceptual model identifies the landfill as operating within a dilute and disperse setting. Under this model, contaminant concentrations may be reduced by processes including dilution, hydrodynamic dispersion, sorption, biodegradation and other contaminant-specific attenuation processes within the surrounding geological and hydrogeological environment.

11.4.71 The acceptability of the landfill's effect on groundwater and other controlled-water receptors is established and controlled through the Environmental Permit, the approved Hydrogeological Risk Assessment and the associated monitoring, compliance and intervention requirements. The ground investigation results reported in ES Appendix 11.6 do not provide a standalone demonstration that attenuation and dispersion will reduce every recorded leachate concentration to an acceptable level before it reaches the aquifer.

11.4.72 The proposed landfill reprofiling works will remain subject to the environmental permitting regime. Any necessary variation to the Environmental Permit will be supported by an updated Hydrogeological Risk Assessment. This will determine whether the existing dilute and disperse conceptual model remains applicable and assess any changes to infiltration, leachate generation and levels, contaminant migration pathways and risks to groundwater and surface-water receptors arising from the proposed works. Any necessary containment, leachate-management, monitoring, compliance and intervention measures will be agreed with the EA through that process.

Off-site Highways

11.4.73 No elevated soil or soil leachate concentrations were recorded across the proposed road alignments and so are not considered to represent a significant risk to the identified receptors.

Conceptual Site Model (CSM) & Environmental Risk Assessment

11.4.74 The following sections discuss all the identified potential on and off-site sources, pathways and receptors in the context of the Proposed Development and plausible contaminant linkages which may represent a risk to identified receptors such as human health and/or Controlled Waters from the data gained from the desk studies and subsequent ground investigations completed (**ES Appendix 11.1, ES Appendix 11.2, ES Appendix 11.4, ES Appendix 11.5, and ES Appendix 11.6**). The CSM derived for the full Application Site area showing significant linkages with a low/moderate or higher risk is provided in Table 11.10. The CSMs and linkage risk assessments are presented in **ES Appendix 11.4** (Main Site)**, ES Appendix 11.5** (Off-Site Highways)**, and ES Appendix 11.6** These include contaminant linkage assessment between landfill-derived contaminants, groundwater migration and controlled waters.

Table 11.10: Conceptual Site Model

Source	Pathway	Receptor	Con	Prob	Risk
On Site (north east of the Main Site) - Landfill Made Ground materials present in the historical Ardley Landfill to the east of the site. Potential contaminants may include metals, asbestos fibres, PAHs and petroleum hydrocarbons, phenols, VOCs and SVOCs.	Direct contact, incidental ingestion, and inhalation of particulates.	Site users	Md	Lw	M/L
On Site (north east of the Main Site) - ground gases (carbon dioxide and methane) from organic materials from Ardley Landfill to the east of Main Site.	Migration, build up and asphyxiation.	Site users	Md / Sv	Lw	M
	Migration, build up and explosion.	Site users	Md / Sv	Lw	M
		Buildings on site	Md / Sv	Lw	M
Off-site PFAS contamination associated with historical firefighting activities at former RAF Upper Heyford Airfield	Migration via surface watercourses and groundwater flow	Controlled waters (surface water, groundwater and aquatic ecosystems)	Md	Lw	M/L
VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low KEY: Con = Consequence, Prob = Probability, Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, Ul = Unlikely					

11.4.75 The contaminant linkage assessment for Ardley Landfill forms part of the existing baseline environment, is regulated under the Environmental Permit, and is not considered a new significant effect of the Proposed Development.

Ardley Landfill - Risk to Human Health

11.4.76 The Main Site is located immediately adjacent to Ardley landfill site which has an active landfill gas management system which controls the possible migration of landfill gas. The landfill also extends onto the north east area of the Main Site where a railway siding is proposed. The ground gas risk is considered to be limited to any proposed warehousing units in Zones A1, A2 and A3 of the Parameters Plan in the east of the Main Site. The current gas management system is likely to require adaptation as the proposed earthworks will disturb current management measures.

Geologically Sensitive Sites

11.4.77 Two SSSI's are recorded within the vicinity of the Application Site and further details are provided in Table 11.11 below, the locations of which are set-out in ES Chapter 6 (Ecology).

Table 11.11: Site of Special Scientific Interest (SSSI)

Site of Special Scientific Interest (SSSI) within 500m of the Application Site	**Location (Site Area)**
Ardley Cutting and Quarry, which is designated due to geological interest for its exposures of Jurassic rocks and has biological interest associated with limestone grassland, scrub, ancient woodland, and wetland habitats. Dated from 2009. It is noted that this SSSI is listed as 'unfavourable – recovering'.[31]	Along the Chiltern Railway Line cutting, (east of the B430)
Ardley Trackways, which is designated due to the presence of fossilised dinosaur (sauropod and theropod) footprints which form trackways. Dated from 2010.	Southern unit at Ardley / Dewars Farm Quarry **offsite** (southeast of the Application Site)

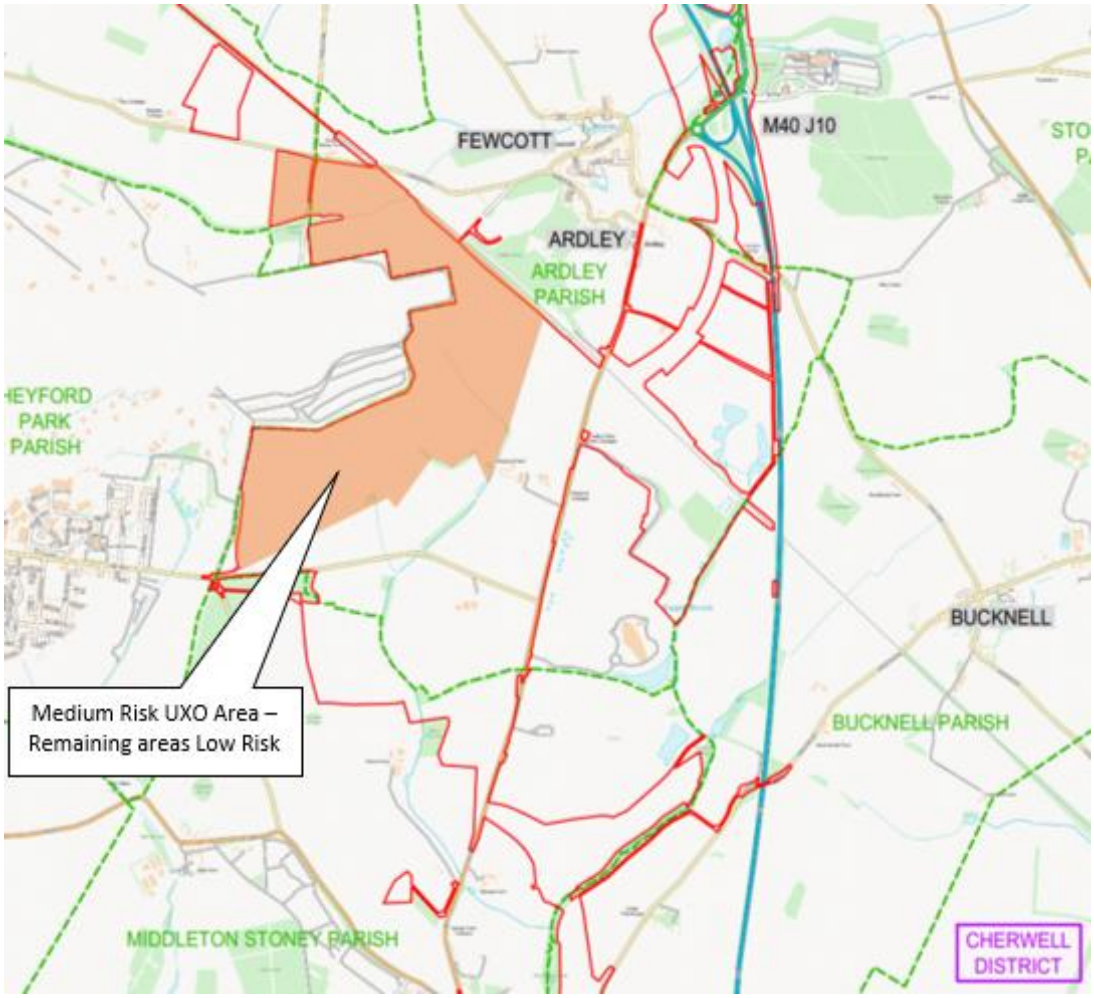
11.4.78 No GWDTEs have been identified on the Application Site or within the Study Area.

[31] There is no pedestrian or public access to observe / log the geological features without consent from Network Rail.

Unexploded Ordnance

11.4.79 The risk from items of UXO are not considered to be homogenous across the Application Site (See **ES Appendix 11.4**). There is an assessed Medium Risk from items of German aerial delivered UXO, items of anti-aircraft UXO and items of Allied UXO within the north-western section of the Application Site. Whereas there is an assessed Low Risk from items of German aerial delivered UXO, items of anti-aircraft UXO and items of Allied UXO across the remainder of the Application Site. A risk area classification Plan is presented below showing areas of increased risk as **ES Figure 11:2** below.

Figure 11:2: UXO Risk Classification Plan



Mineral Resource

11.4.79 The site is located in a Minerals Safeguarded Area (MSA) with limestone rock of the White Limestone Formation being the safeguarded mineral. Mineral extraction has been undertaken historically in the surrounding area, with

several small-scale limestone pits and quarries noted on historical maps and in the Hydrock reports (within **ES Appendix 11.1** and **ES Appendix 11.2**). In addition, significant limestone quarrying operations have occurred at:

- Ardley/Dewar's Farm Quarry, located to the south of Ardley Quarry; to the immediate east / south-east of the Main Site. This quarry is noted to be 'active'. For further information with regard to the Ardley/ Dewar's Farm Quarry, please refer to the information below.

- The historical Ardley Quarry (also known as Ardley Fields Farm Quarry), located to the east of the Main Site, on the eastern side of the B430 road. Small scale mining occurred historically (late 19th Century). Large scale quarrying appears to have commenced in the late 1970s and worked north to south. Mineral extraction appears to have been completed by the late 1990s in this area and the area was backfilled as a landfill (Ardley landfill). Restoration commenced in the early 2000's and the Ardley ERF facility was constructed in the south of the area during the early 2010s.

- The historical Ardley Woods Quarry, located to the north of the Main Site (on the northern side of the railway line). This was quarried (small scale) in the late 19th Century and appears to have been mined more extensively in the late 1970s and early 1980s. It is noted as disused by 1992. This quarry now forms part of the Ardley Cutting and Quarry SSSI (Table 11.8).

- The historical Ardley Quarry Extension, located to the north-west of the Main Site; north of the Ardley Quarry (on the northern side of the railway line). This was quarried in the early 2000s and is now partially restored (vegetated, with ponds in the east of the former quarry). This quarry now forms part of the Ardley Trackways SSSI.

11.4.80 The Ardley/Dewar's Farm Quarry is an existing operational limestone quarry. Planning permission 18/01610/CM, granted on 26 October 2018, permitted the continuation of limestone and clay extraction until 2028, with restoration commencing in 2029. A further extension, permitted in May 2025 under planning permission MW.0049/23, allows the extraction of approximately 2 million cubic metres of limestone and is expected to extend quarrying by approximately eight years. As shown on Figure 4.1 of the updated Minerals Assessment (Appendix 11.3), the proposed Middleton Stoney Relief Road lies

outside the mineral extraction areas currently permitted and would not prevent the extraction of the full permitted mineral resource.

11.4.81 Limestone is generally recorded within 1.0m of the Main Site surface, with a workable thickness of limestone of up to 7.0m based on local BGS records and extraction amounts at the adjacent quarry. Given that the limestone thins out towards the north west of the site, and a significant valley running centrally through the site, it is considered likely to average less than this. Given the approximate Main Site area of 200 ha, reduced to circa 140ha if suitable buffers of around 50-100m are provided around water courses and sensitive adjacent site uses, this equates to an estimated 27.44 M tonnes of limestone (based on a bulk density of 2.8 tonne/m^3) present on site. Therefore a potentially viable mineral resource exists on the Main Site. Current sales rate for limestone from Oxford indicate that this would provide over 27 years of supply, based on recent sales of just under 1M tonnes per annum.

11.4.82 Although there is a deficit of limestone for Oxfordshire under the Minerals & Waste Core Strategy plan period (up to 2031), it is unlikely that there will be an economic demand for this volume of the mineral if extracted for sale prior to development, as the proposed extraction rate would vastly exceed demand.

11.4.83 Minerals Core Strategy policies allow for planning permissions for development to be granted over a protected mineral (Oxfordshire Minerals and Waste Core Strategy, 2017, Policy M5) if it can be demonstrated that the mineral can be excavated (through a borrow pit for example) and used on site during the construction phase with minimal use of public highways. Any mineral excavated in this way can only be used in connection with the project.

11.4.84 Later sections of this Chapter set out the proposed approach to the safeguarded mineral resource, including mitigation measures, with reference to the Minerals Assessment (at **ES Appendix 11.3**).

Future Baseline

11.4.85 Based on the assessment of the current state of the baseline conditions, there are no significant adverse effects on the Main Site from the current activities were they to continue unchanged (and in the absence of the Proposed Development). With regard to the other areas of the Application Site, localised contamination within landfill deposits is unlikely to present a risk to human health. Unless further investigation identifies soil concentrations in excess of the applied Human Health screening criteria in the vicinity of the contamination

sources identified such as the soil treatment facility and the service station beyond the A43, risk to human health will remain low.

11.4.86 The risk to groundwater bodies and surface water is not expected to change at the Application Site in the future as existing site uses are unlikely to cause significant impact.

11.4.87 The actual conservation state of the Ardley Cutting and Quarry SSSI is listed as 'unfavourable – recovering', which is considered likely to continue unless some improvement is scheduled by regulatory action. If the calcareous grasslands were to recover, this would likely be to the detriment of Jurassic rock exposure.

11.5 ASSESSMENT OF LIKELY EFFECTS

11.5.1 The assessment of likely effects considered 'embedded' design or mitigation measures which form part of the Proposed Development. This Section of the Chapter begins by setting out the key embedded measures before considering the likely effects on ground conditions and associated receptors.

Embedded Mitigation – Construction Phase

11.5.2 A CEMP (ES Appendix 2.3) details mitigation measures to control the risks to surface water and groundwater receptors and the health of construction workers during the construction phase. These measures include routine inspection of watercourses, pollution prevention controls, incident response procedures and reporting mechanisms. Consequently, the likelihood of a significant impact upon controlled waters is considered low. The Framework CEMP for the project is enclosed as ES Appendix 2.3. The CEMP provides the context and framework for phase specific CEMPs (P-CEMPs) as part of each phase or element of the project.

11.5.3 The CEMP (ES Appendix 2.3) draws on good practice such as CIRIA C811 Environmental Good Practice on Site Guide and CIRIA C670 Site Health Handbook during construction works. It incorporates many standard and common safety and other measures to minimise effects during the construction process, including requiring adequate standard personal protective equipment and the development of basic hygiene measures to be implemented.

11.5.4 Prior to commencement of relevant works, detailed contamination management measures shall be incorporated within the approved phase specific CEMP (P-CEMP) and any site-specific remediation documentation. These measures shall include procedures for dealing with previously unidentified contamination, management of contaminated soil and groundwater, protection of controlled waters and implementation of emergency pollution response procedures where required.

11.5.5 Measures will be undertaken to minimise the potential for the movement of sediments into surface watercourses, which may include seeding stockpiles, silt traps and temporary drainage grips.

11.5.6 Mitigation measures associated with UXO awareness and finds is included in the CEMP (ES Appendix 2.3).

11.5.7 Spillages (such as oil, fuel, cement, chemicals etc.) and soil erosion or the generation of suspended solids during construction activities will be controlled through the implementation of the CEMP (ES Appendix 2.3). Designated fuelling areas for plant would be set up with suitable double bunding for tanks, spill kits available and an emergency plan in place for dealing with any spills.

11.5.8 The reprofiling of the former landfill will be strictly undertaken in accordance with an Environmental Permit to be agreed with, and issued by, the EA. This will include a hydrogeological risk assessment to demonstrate that the reprofiled landfill does not present an environmental risk, and particularly the underlying Principal Aquifer and surrounding water courses. Detailed construction methodologies have not yet been finalised and therefore temporary dewatering requirements, if necessary, will be determined during detailed design. Any dewatering activities would be undertaken in accordance with the requirements of the Environmental Permit and any necessary environmental approvals in place at the time of construction. Appropriate controls would be implemented to protect groundwater quality and landfill leachate management systems. The mitigation measures will include a clay cap to limit infiltration and a leachate management system.

11.5.9 Ground investigations have identified the presence of putrescible waste materials within the former Ardley Landfill within the Proposed Development area. The decomposition of organic waste within this landfill is generating hazardous ground gases (methane, and carbon dioxide). These gases can pose a risk to human health through inhalation and, in confined spaces, through asphyxiation or the creation of explosive atmospheres. Given that the proposed works involve groundwork within the footprint of the former landfill,

there is an increased potential for worker exposure to these ground gases during construction activities. However, it is noted that all earthworks are anticipated to be conducted in open-air conditions, which will significantly reduce the likelihood of gas accumulation to levels posing an immediate asphyxiation risk. Ardley Landfill has an active ground gas management system which covers Cells A, B, and D on the Application Site, and also serves landfill cells of the adjacent wider Ardley Landfill site. The Proposed Development plans do not include the construction of buildings within the boundaries of the former landfill area. This absence of enclosed spaces substantially reduces the probability of significant gas build-up leading to potential explosive conditions. Overall, the significance of effect of ground gases in Ardley Landfill is potentially of moderate impact, due to medium likelihood and moderate magnitude. The management of hazardous ground gases would be a requirement of the EA permit for the landfill, as it does currently on the landfill site.

11.5.10 For works within Ardley Landfill, a detailed Remediation Strategy will be prepared to meet EA requirements and comply with EA permit / licensing requirements[32]. This remediation will also facilitate the appropriate reuse of soils and material within the site. This would include ground gas monitoring during earthworks to ensure that any exposure of site workers to hazardous gases is controlled. To mitigate against potential risks, services personnel will follow guidance stated in 'HSE 66 Protection of Workers and the General Public during Development of Contaminated Land' during construction works.

11.5.11 The timescales for the Proposed Development allow offsite receiver sites to be found in the region as the project progresses to avoid disposal of material to landfill. Re-use of soil materials would be facilitated under a Material Management Plan (MMP)[33] under the CL:AIRE Definition of Waste Code of Practice (DoWCoP)[34] prepared prior to development commencing.

11.5.12 The CL:AIRE Definition of Waste: Code of Practice is used to demonstrate that excavated soils that are re-used meet the criteria for:

- Protection of human health and protection of the environment;
- Suitable for use without further treatment;
- Quantity of use; and
- Certainty of use.

[32] ES Appendix 13.1 Landfill Reprofiling Technical Note provides an overview of the works proposed.
[33] An MMP will be prepared alongside a Site Waste Management Plan under the structure provided by the framework CEMP (ES Appendix 2.3, Document 6.2C).
[34] CL:AIRE The Definition of Waste: Development Industry Code of Practice Version 2 March 2011

11.5.13 The proposed development includes the reuse of circa 3.8M m^3 of soil and rock. In accordance with Oxfordshire Minerals and Waste Local Plan (adopted 2017) Policy M5, it is proposed to maximise the reuse of the on-site (Development Site) safeguarded White Limestone Formation mineral so that it does not have an impact on the demand of limestone minerals from the region. Further details on mineral demand for the Proposed Development is provided with the Waste Chapter (Chapter 13).

11.5.14 Part of Ashgrove Farm is to be retained and redeveloped (re-used) as part of an on-site 'hub' for facilities. Within the structure of the CEMP (ES Appendix 2.3) (and via a future P-CEMP), prior to the demolition of existing structures, a pre-demolition asbestos survey will be undertaken, in accordance with Control of Asbestos Regulations 2012. This must be completed to identify all asbestos and enable a plan of work to be prepared to safely remove any asbestos.

11.5.15 The design will require significant earthworks to prepare platforms for development. A cut and fill balance will be obtained to avoid importation or export of materials. Topsoil will be stripped and stockpiled with a volume retained for use in soft landscaping. An earthworks specification will be prepared setting out the methods by which materials will be handled and re-engineered and the verification requirements to demonstrate that works have been completed to an acceptable standard.

11.5.16 Fill materials will be placed to an end-product specification to avoid differential settlement issues and additional reinforcement is likely to provide support where any structures span over cut and fill areas. Additionally, cut and fill slopes will be suitably designed to achieve global stability and ensure health and safety of any workers, and the public is ensured.

11.5.17 Works near to existing rail and road structures will be subject to detailed geotechnical design and assessment approval in accordance with Highways England Design Manual for Roads and Bridges CD 622[35] in the case of the National Highways and to Network Rail Standards. This involves identifying risks early, assessing them, and implementing mitigation strategies. Slopes will require detailed assessment and appropriate design, retaining and temporary shoring.

[35] CD 622 , Managing Geotechnical Risk, Version 1 March 2020

11.5.18 Some removal of existing Jurassic rock faces, which is a moderate sensitive geological SSSI (Ardley Cutting and Quarry SSSI), will be required to facilitate development, namely, the south east rail entrance for the Railfreight Terminal. This is detailed in the Technical Note presented as **ES Appendix 11.10**. Current proposals will require the removal of circa 350m of Jurassic rock face. However, the Jurassic rock face currently within the Ardley Landfill (circa 95m long) is to be retained and further exposed as well as an additional area of Jurassic rock face exposed along the new rail alignment. It should be noted that the rock faces are all in inaccessible locations and the SSSI status is 'unfavourable – recovering'. Across much of the SSSI, there are no exposed rock faces. Overall, the development will create additional rock faces within the Jurassic limestone rock.

Embedded Mitigation – Operational Phase

11.5.19 Low concentrations of ground gas have been recorded and are not expected to be at significant levels beneath the Main Site. However, high concentrations of hazardous ground gas are expected in the vicinity of Ardley Landfill. Without mitigation, there is a low potential for a major effect associated with the migration of ground gases accumulating within confined spaces offsite leading to asphyxiation (carbon dioxide) or explosion (methane). Users of the public bridleway which will pass through the remodelled Ardley Landfill have a medium likelihood of being affected by contamination and hazardous ground gases where it runs through the landfill site.

11.5.20 The management and monitoring of hazardous ground gases and ground contamination at the former Ardley Landfill are subject to the requirements outlined in the Environmental Permit issued by the EA. Adherence to the conditions of this permit, as amended to accommodate the Proposed Development, will be crucial in mitigating potential risks associated with ground gases and soil contamination during and potentially after the Proposed Development.

11.5.21 Fuel storage facilities required for the rail terminal will be bunded with appropriate wet stock management and spill management systems. Refuelling areas will be constructed within designated areas provided with an engineered impermeable hardstanding (e.g. concrete or asphalt surfacing) that prevents fuels, oils or other hazardous substances from infiltrating into underlying soils and groundwater. These areas would be managed in accordance with the Outline CEMP and would be provided with appropriate spill prevention and response measures, including spill kits and the immediate containment and clean-up of any accidental releases. The measure is intended to control

potential contamination pathways to soil and controlled waters during construction activities.

Assessment of Likely Effects

Construction Phase

11.5.22 As part of the development of the Main Site, a large earthworks exercise will be undertaken to create level development plateaus for warehouse buildings (and the rail terminal), with up to 12.0m of cut required in places. The earthworks model has been designed to balance the amount of cut taken and the amount of fill required, with the intention that no additional material will be required to be imported or exported from the Main Site presenting a negligible effect on mineral resource. Earthworks modelling for the highways has been designed to establish a cut fill balance, negating unnecessary import or export requirements. Any import for engineering purposes will be limited to materials that cannot be generated on the Application Site.

11.5.23 Construction activities have the potential to encounter previously unidentified contamination associated with historic land uses, imported materials, infilled ground or adjacent permitted waste management activities. Where contamination is encountered, works would be undertaken in accordance with the CEMP, Remediation Strategy and Materials Management Plan. Any unexpected contamination would be subject to investigation, risk assessment and implementation of appropriate remediation measures as required by the relevant planning and environmental permitting controls.

11.5.24 Most future warehouse units will be located on plateaus with a portion of cut and fill required on each plot. Currently, only the western edge of Zone A3 on the Parameters Plan is placed wholly in cut (see CEMP (ES Appendix 2.3)). Given the shallow bedrock, breaking out competent rock will create a significant constraint at the Main Site. The rock will need to be removed by ripping by utilising tracked bulldozers.

11.5.25 Based on the proposed earthworks strategy and engineered placement of the material to an end-product earthworks specification, shallow footings and ground bearing floor slabs are expected to be suitable for the Proposed Development.

11.5.26 Where the rail alignment cuts through the existing area of Ardley Landfill, remodelling of the landfill will be required so that the final developed area of the Application Site does not fall within the EA licensed landfill area. The

current proposal is that the landfill waste will be excavated and placed atop the existing Ardley Landfill within Cells A and B. This will include removing the existing mineral cap placing the existing waste and capping it with a new mineral cap that conforms to Waste Framework Directive[36] requirements. This will require a variation of the current waste license. Discussions have been held with the EA to agree the exact mechanism and requirements for this, as detailed in the ES Chapter 13 (Materials and Waste).

Risk to Human Health

11.5.27 Asbestos contaminated soils may be retained on the Main Site beneath hard standing subject to a risk assessment and preparation or a safe system of work under the Control of Asbestos Regulations 2012, thereby minimising any residual risk.

Risks to Controlled Waters

11.5.28 The risk to controlled waters is increased where groundwork is required within the former Ardley Landfill Area. There is a medium likelihood that the Made Ground associated with the landfill will contain leachable contaminants at elevated concentrations. Due to the underlying Principal Aquifer, the magnitude of leachate infiltrating the groundwater is moderate, thus, the effect is of moderate adverse significance.

11.5.29 As referred to above, investigations undertaken in 2026 confirmed the presence of low concentrations of PFAS within surface waters, sediments and limited groundwater locations across the Main Site. The distribution of detected PFAS indicates that the principal source is likely to be historical activities associated with the former RAF Upper Heyford Airfield, with the Main Site acting primarily as a receptor and migration pathway rather than a primary source.

11.5.30 During construction there is potential for excavation and handling of sediments containing trace PFAS concentrations, particularly in connection with watercourse realignment works. This could result in limited mobilisation of PFAS-containing sediments and waters. However, the concentrations identified are low, the volume of affected material is limited, and the implementation of the pollution prevention measures and remediation

[36] Directive - 2008/98 - EN - Waste Framework Directive

procedures identified in the CEMP (to be secured in detail via phase specific P-CEMPs) would minimise the potential for contaminant mobilisation.

11.5.31 During operation, the proposed drainage strategy, hardstanding cover and operational management measures would not be expected to increase migration of PFAS beyond baseline conditions. Consequently, impacts to controlled waters arising from PFAS are assessed as negligible to minor adverse and not significant.

11.5.32 A significant earthworks exercise is required to create development platforms for the Proposed Development. This includes significant areas of cut into the limestone bedrock across much of the site, this is 3.0m or less, which would comprise topsoil, weathered limestone, and initial horizons of limestone. Resting groundwater levels recorded are below the upper layers of cut indicated and so permanent groundwater will not be encountered across the majority of the development. More significant areas of cut will be needed for the proposed rail freight terminal itself (the SRFI). The site falls within the Oxon Ray WFD catchment which is part of the Thames regional catchment, except the very northern part of the SRFI which falls into Great Ouse Upper WFD catchment, part of the Anglian Regional catchment. Based on the cut and fill areas, the only part of the site that may encounter groundwater during groundworks are where the rail freight terminal is present and cut is down to the underlying Rutland Formation confining layer, to tie into levels of the adjacent Chilton Main Line. The SRFI is at the head of the regional catchment boundary between the Thames and Anglian catchment, Groundwater is a limited issue at the hydrogeologically downgradient quarry and can be managed by surface water drainage (see Chapter 9) as with the adjacent Chilton Main Line. Therefore, the development will have low likelihood of a minor adverse effect on the groundwater regime because of the earthworks, leading to potential of a minor adverse effect.

11.5.33 It is unlikely that a piled foundation will be required for the Proposed Development, unless a particular structure has a low settlement tolerance. If piling was undertaken there is a low likelihood that piling would create a preferential pathway for contamination to have a moderate impact on the underlying Principal Aquifer, potentially having a moderate adverse effect.

Risks to Geology, Buildings and Structures

11.5.34 As described, the earthworks require cut and fill of approximately 3.8Mm^3 of soils and rock across the Main Site to create development platforms, railbed and roadways. Earthworks have a low likelihood to cause local instability of

moderate magnitude particularly around existing slopes and retaining structures associated with the rail mainline cutting and M40 embankments. The effect on buildings and structures during construction are considered to be of minor adverse significance, confined to localised areas but could be permanent duration. There is the low possibility that Climate Change could increase precipitation inundation in the short term potentially increasing the likelihood of failure of temporary earth structures that could result in moderate adverse effects.

11.5.35 The Development will lead to limestone mineral sterilisation at the site. Mineral resources will be conserved by using all excavated minerals from development of the Main Site. This will therefore make effective, productive use of site-won exploited mineral whilst avoiding creating additional demand on the existing mineral supply. It would also enable reductions in the traffic associated with the movement of mineral products on local highways. There is therefore a likely minor adverse effect because of the low sensitivity of loss of mineral resource having minor magnitude of impact.

11.5.36 The Proposed Development will not affect the Ardley Trackways SSSI which is entirely off-site. The Application Site is wholly underlain by Jurassic limestone rock, creating the possibility, although low, that the limestone contains further surviving dinosaur footprint fossils. The earthworks operation is predominantly limited to the upper 3m of the limestone which has a high degree of weathering and where dinosaur fossils are not considered likely as a result. Only for the rail freight terminal area (Zones B and C) and the western part of Zone A4 will deeper excavations be undertaken where there is a possibility (albeit still very low) of encountering geology which might feasibly contain dinosaur footprints/fossils. The Ardley Trackways SSSI is outside the Application Site which has no designation relating to heritage or paleontological features, so there is considered to be a High sensitivity of moderate significance resulting in a moderate adverse effect in the absence of any additional mitigation.

Other Risks

11.5.37 Control on the impacts of noise, vibration, dust, and odour will be employed throughout the construction in consideration of the residential properties in the vicinity of the Application Site. These effects are considered in detail in ES Chapter 4 (Air Quality and Odour), ES Chapter 5 (Noise and Vibration) and ES Chapter 6 (Ecology).

Operational Phase

Risk to Human Health

11.5.38 The Application Site once developed will include large areas of built development which will be the predominant focus of human activity and presence on the site (notwithstanding the significant areas of green infrastructure within the Application Site), and therefore there is a low likelihood of future site users being exposed to any soil or groundwater contamination. Contact with any potentially contaminated materials is unlikely to occur at all, but would be limited to areas of landscaping, especially at the proposed conversion of Ashgrove Farm, and other localised areas in relation to former buildings and agricultural infrastructure such as tanks and storage units associated with the farm. Albeit low likelihood, the magnitude would be moderate and so the potential effect is minor adverse.

Risks to Controlled Waters

11.5.39 The presence of significant hard standing will reduce the infiltration of rainfall and subsequent leaching of any soluble contamination in shallow soils into underlying groundwater (Undifferentiated, Secondary B and Principal Aquifers) and surface waters. Runoff from goods vehicles using the Main Site and Highways has the potential to be impacted by heavy metals and petroleum hydrocarbons. Railway maintenance areas may involve storage of chemicals including fuels, lubricants and cleaning products. Temporary waste storage areas may be required. The effect on Controlled Waters from these sources during operation across the Application Site are considered to be of minor adverse effect significance based on low likelihood and moderate impact and would be confined to a localised area and of short to medium duration.

Risks to Geology, Buildings and Structures

11.5.40 Based upon the proposed earthworks, some buildings will be constructed on a significant thickness of engineered fill. There is a medium likelihood of moderate magnitude that poorly compacted or uncontrolled earthworks could cause significant settlement, which could have a moderate adverse effect to buildings. Due to many of the proposed warehousing units potentially being placed on a combination of cut (into solid limestone bedrock) and fill (excavated soils and/or rock), there is the potential for differential settlement issues arising.

11.5.41 The development could lead to the loss of small sections of rock face of the geological SSSI in the railway cutting along the northern fringe of the site. However, this area is currently inaccessible to geologists as it is an active railway and so the current significance of effect is minor adverse based on a moderate impact of low sensitivity, although much of the rock exposure will remain and new exposures will be created.

Summary of Likely Effects

11.5.42 Table 11.12 below summarises the likely effects in the absence of additional mitigation:

Table 11.12: Summary of Likely Effects

Issue	Impact	Level of Effect
Construction Phase		
Mobilisation of contamination impacting upon controlled waters in the Ardley Landfill Area	Moderate	Moderate Adverse
Disturbance and mobilisation of PFAS contamination in watercourses including silt	Minor	Minor Adverse
Changes to the groundwater regime as a result of the proposed earthworks exercise at the SRFI	Minor	Minor Adverse
Deep foundations (piling) creating preferential contaminant migration pathways	Moderate	Moderate Adverse
Instability of slopes and retaining structures created during construction as a result of the earthworks exercise.	Moderate	Moderate Adverse
Loss of limestone mineral resource	Minor	Minor Adverse
Loss of other Jurassic rock fossils (no status)	Minor	Moderate Adverse.
Operational Phase		
General exposure of end users to contaminated soils and groundwater	Minor	Minor Adverse
Asphyxiation or exposure due to accumulation of hazardous ground gases in confined spaces for buildings in the east of the Main Site in proximity to Ardley Landfill	Major	Moderate Adverse
Contaminated runoff from goods vehicles using the Main Site and Highways effecting controlled waters (local watercourses and the underlying Principal Aquifer)	Moderate	Minor Adverse

11.6 ADDITIONAL MITIGATION AND RESIDUAL EFFECTS

11.6.1 As previously outlined, potential significant effects in this assessment are those of moderate/minor impact or worse. As part of the EIA process there is

an emphasis on seeking to mitigate and minimise such potential effects, and this section of the Chapter considers whether any additional mitigation measures (in addition to those already 'embedded') might further reduce the likelihood of significant effects.

11.6.2 This process also considers a number of potential likely but not significant effects identified above that could still be further mitigated.

Construction Phase Additional Mitigation

Risk to Human Health

11.6.3 No additional mitigation is required with regard to Human Health.

Risks to Controlled Waters

11.6.4 The scale of the Proposed Development will allow any required soil treatment such as bioremediation to be completed and soils retained for re-use. Any remediation would be completed under an Environmental Permit, Position Statement, Treatment License or appropriate exemption obtained by the remediation contractor.

11.6.5 The CEMP (ES Appendix 2.3), and associated Materials Management Plan shall include consideration of PFAS-contaminated sediment and water where encountered during construction. Sediment generated during watercourse modifications shall be subject to appropriate risk assessment to determine whether reuse on-site is suitable or whether off-site disposal is required. Any management of PFAS-impacted materials shall be undertaken in accordance with relevant regulatory guidance and agreed remediation objectives.

11.6.6 In the unlikely scenario that a penetrative foundation solution is required, a Foundation Works Risk Assessment should be completed specific to the activity being undertaken. This shall be undertaken in accordance with CL:AIRE guidance[37].

Risks to Geology, Buildings and Structures

11.6.7 A watching brief by a palaeontologist will be undertaken during excavations in the Shipton Member (See **ES Appendix 11.9** for the areas where this will be

[37] CL:AIRE Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, March 2025

required). If during the groundworks in Jurassic rock, features such as dinosaur footprints or other potentially rare artefacts are encountered, then works should cease and the archaeologist at the local authority contacted. A palaeontologist will need to examine any footprints to determine the species, age, significance and condition to inform how to proceed. Depending on the significance of any find, steps may be taken to preserve the footprints such as careful excavation, examination and removal of the fossils, or on-site preservation measures including detailed documentation including photography and 3D laser scanning. Details of the background to the dinosaur trackways and proposed mitigation methodology should this scenario occur is included within **ES Appendix 11.9**.

11.6.8 Detailed design and management of the replacement Jurrassic rock face exposures will be undertaken in consultation with Natural England and a suitably qualified geologist. This will be secured through a geological exposure mitigation and management scheme, which will include geological supervision, recording of significant features and long-term management of the exposed faces.

Construction Phase Residual Effects

Human Health

11.6.9 The implementation of a Remediation Strategy and asbestos surveys / removal from buildings and adherence to industry guidance documentation during construction will leave a **negligible** residual effect based on a low likelihood of a negligible magnitude impact.

Risks to Controlled Waters

11.6.10 Treatment / removal of any significant localised contamination will adhere to a Remediation Strategy and/or Environmental Permit conditions accordingly. Therefore, the residual effect will be **negligible** due to low likelihood of a negligible magnitude impact.

11.6.11 By installing any piled foundations in accordance with an EA approved Foundation Works Risk Assessment the residual effect on the underlying Principal Aquifer will be negligible due to low likelihood of a negligible magnitude impact.

Risks to Geology, Buildings and Structures

11.6.12 By retaining mineral resources on site and ensuring that additional demand is not put on external resources that can be sourced on site there will be **minor adverse** effect on loss of mineral resources based on a minor effect magnitude of low sensitivity.

11.6.13 By implementing the contingency measures presented in **ES Appendix 11.9**, there will be a negligible effect on fossils/artefacts associated with the Jurassic Rock based on a **negligible** effect magnitude of low sensitivity. There will be a **minor beneficial** effect on Jurassic Rock exposures as the mitigation will create additional rock exposures having minor impact of a moderate sensitivity feature.

Operational Phase Additional Mitigation

Risk to Human Health

11.6.14 To mitigate the possible risk to Units developed in Zones A2, A1b and A1a (as shown on the Parameters Plan) from ground gas migration from Ardley Landfill, gas protection measures will need to be installed pre-occupation for these Units. The gas protection will be installed in accordance with BS8485:2015+A1:2019 to meet the level of protection required in the different zones of the buildings (i.e. small office / welfare spaces or large open warehouse spaces).

11.6.15 The remodelled Ardley Landfill will be designed with a clay mineral cap, with inert surface soils, and a gas and leachate management system installed. Any limited surface emissions will be readily dispersed to the atmosphere. The measures will all be agreed with the EA under the landfill's varied / new Environmental Permit. ES Appendix 13.1 also provides an overview of the proposed landfill reprofiling works proposed.

11.6.16 Adequate standard personal protective equipment and the development of basic hygiene measures will be undertaken, following relevant guidance from 'HSE 66 Protection of Workers and the General Public' for on-site estate management or other on-site workers (such as landscapers or gardeners).

Risk to Controlled Waters

11.6.17 Once reprofiling of the landfill has been completed and the Main Site is operational, annual monitoring of the surrounding Principal Aquifer will be undertaken to ensure that the landfill complies with the terms of the EA license. If there are any significant breaches then intervention will be undertaken with

any remediation strategy to be agreed with the EA before implementation. This will all be agreed on the terms of the amended Waste Permit for the site; this is discussed further in the Materials & Waste Chapter (Chapter 13).

11.6.18 Earthworks cut in the SRFI area in the north west of the Main Development will likely encounter groundwater. The drainage strategy (see Chapter 9 for details) in this area will be designed to manage water which will possibly enter at the interface with slopes along the south west side of the SRFI.

Risks to Geology, Buildings and Structures

11.6.19 Management of Jurassic rock faces will be undertaken in accordance with a mitigation and management scheme developed in consideration of NE guidance NE789[38]. The overall scientific integrity of the new exposures will be managed through mitigation and maintenance aligned with NE789, which will include long-term management of the exposed faces would lead to a minor impact on a moderate sensitivity receptor would have an overall minor beneficial effect.

Operational Phase Residual Effects

Human Health

11.6.20 Implementation of a comprehensive remediation strategy will remove any unacceptable risk to future site users. The residual effect will be **negligible** due to low likelihood of a negligible magnitude impact.

11.6.21 Following the implementation of gas protection, any effects are unlikely to occur with the residual effect **negligible** due to negligible magnitude impacts.

11.6.22 There will be a residual small increased potential for direct human exposure to potential contamination identified in shallow soils through ingestion, direct contact or inhalation of contaminated soil. Adequate standard personal protective equipment and the development of basic hygiene measures (following relevant guidance from 'HSE 66 Protection of Workers and the General Public' referred to above) for on-site estate management or other on-site workers (such as landscapers or gardeners), coupled with implementation of an agreed remediation strategy will remove any unacceptable or significant

[38] Natural England General Publication NE789 *Geoconservation: principles and practice*

risks to future site users. The residual effect will be **negligible** due to low likelihood of a negligible magnitude impact.

11.6.23 The mitigation measures for the remodelled Ardley Landfill will result in an effect being unlikely and a negligible magnitude impact and so an overall effect of **negligible** significance.

Risks to Controlled Waters

11.6.24 The predominantly hard standing cover which will be present during the operational phase will minimise the infiltration of rainfall and recharge through the unsaturated zone, thereby minimising potential contaminant mobility and reducing the risk to the underlying aquifer. The residual effect will be **negligible** due to an unlikely minor magnitude impact.

11.6.25 The construction of the SRFI will have a minor effect on the groundwater regime flow pattern but is not expected to affect the wider catchment. The residual effect will be **minor adverse** due to a likely, minor magnitude impact.

Geology, Buildings and Structures

11.6.26 Detailed foundation design, and the associated methodology remains subject to detailed intrusive ground investigations for final geotechnical design, to be undertaken at the appropriate time (post consent) once detailed engineering designs are sufficiently developed. Implementing appropriate geotechnical design would mean it is unlikely that an adverse effect would occur and with moderate impact would have an overall **negligible effect**.

11.6.27 Mitigation and maintenance of Jurassic Rock exposures aligned with NE789, would lead to a minor impact on a moderate sensitivity receptor would have an overall minor beneficial effect.

Climate Change

11.6.28 Careful control and monitoring of earthworks will ensure that the engineered soils are placed in accordance with the earthworks specification. Climate Change has the potential to increase the likelihood for extreme weather events such as precipitation and/or drought which may increase environmental effects such as increase runoff, dust generation and/or geotechnical impact from waterlogged or desiccated soils. However, the impacts will be negligible and the mitigation measures outlined are appropriate for dealing with such eventualities.

Mitigation Summary

11.6.29 Table 11.13 below summarises the potential issue, likely impact, proposed mitigation, and level of residual effect identified.

Table 11.13: Residual Effects Post Mitigation

Issue	Impact	Mitigation	Level of Effect
Construction Phase			
Asphyxiation associated with inhalation of hazardous ground gasses in the Ardley Landfill Areas	Severe	Adherence to the Remediation Strategies and industry guidance. Undertake gas monitoring during ground works during groundworks at Ardley Landfill when dealing with waste reprofiling and adhere to Environmental Permit conditions and Remediation Strategy	Negligible
Mobilisation of PFAS-containing sediment and water during construction earthworks and watercourse modifications	Minor	CEMP, pollution prevention measures, contamination management procedures, remediation strategy	Negligible to Minor Adverse
Mobilisation of contamination impacting upon controlled waters in the Ardley Landfill Area	Moderate	Adhere to Environmental Permit conditions and Remediation Strategy. The Design of the landfill will be in accordance will be in accordance with the Environmental Permit and include leachate management and minimisation of infiltration with a clay cap.	Negligible
Mobilisation of contamination due to piling (although unlikely to be needed)	Moderate	Undertake piling in accordance with a bespoke Foundation Works Risk Assessment for the activity proposed.	Negligible
Loss of (sterilisation of) limestone mineral resource	Minor	Retaining (re-using) exposed, site-won mineral resources on site and ensuring that additional demand is not put on external resources and supply.	Minor Adverse
Loss of potential Jurassic rock fossils (no status) if present on-site	Minor	Implement a 'watching brief' during relevant stages of earthworks (Appendix 11.9)	Negligible
Creation of new additional Jurassic rock faces	Minor	Creation of new Jurassic rock faces in accordance with a mitigation and	Minor Beneficial

		management scheme developed in consideration of NE guidance NE789	
Operational Phase			
Public exposure to hazardous gasses and contamination where the bridleway passes through Ardley landfill	Minor	Installation of a clay mineral cap, with inert surface soils, and a gas and leachate management system.	Negligible
Exposure of end users to contaminated soils and groundwater	Minor	Implement a Remediation Strategy with any significant residual contamination to be recorded on the Site Health and Safety File. Ground workers to implement appropriate (standard) health and safety protocols.	Negligible
Changes to the groundwater regime at the SRFI	Minor	The drainage solution will manage any emergence along slopes.	Minor Adverse
Asphyxiation or exposure due to accumulation of hazardous ground gases in confined spaces for buildings in the east of the Main Site in proximity to Ardley Landfill	Major	Install gas protection measures in accordance with BS8485:2015+A1:2019 for Zones 1a, 1b and 2.	Negligible
Degradation / loss of Jurassic rock face due to vegetation / degradation	Minor	Management of Jurassic rock faces in accordance with a mitigation and management scheme developed in consideration of NE guidance NE789	Negligible

Residual Effects Post Mitigation Summary

Construction Phase

11.6.30 Following implementation of the outlined, the Construction Phase residual effects will be **Negligible, to Minor adverse, and not significant.**

Operational Phase

11.6.31 Following mitigation the residual effects during the Operational Phase will be **Negligible, to Minor adverse, and not significant.**

11.7 CUMULATIVE EFFECTS

11.7.1 A list of the 'committed developments' to be considered across the ES (see ES Chapter 1 (Introduction)) for an assessment of likely cumulative effects was agreed with the local authority. The existing or permitted schemes that are relevant to, or could represent a cumulative impact with, the Proposed Development regarding Ground Conditions, includes the following as detailed in Table 11.14 below:

Table 11.14: Cumulative Sites

Site	Description	Location
Heyford Park	Application for 1,175 dwellings approved (with Scoping submitted in 2024). Additional (live) and uncommitted planning application for a 'new town' of 9000 homes and other uses.	Immediately west of the Main Site.
Bicester urban extension ecotown	6,000 homes total, local centre hubs, 4 primary and 1 secondary school and other community facilities, and 10ha (min.) employment. Allocated in 2015.	Approximately 1 – 1.5km from Highways Works; approx. 2.5km from Main Site.
The 'Great Wolf' leisure resort	New leisure resort (sui generis) incorporating waterpark, family entertainment centre, hotel, conferencing facilities and restaurants with associated access, parking and landscaping.	Chesterton (west of Bicester), approximately 2km from Highways Works; approx. 3km from Main Site
David Wilson Homes residential site	Residential development for 123 homes	Approximately 250m west of the Main Site
Distribution development proposals (by Albion Land and Tritax)	Total 580,000 sqm (GIA) of logistics floorspace	In the vicinity of the A43, north of M40 Junction 10 - adjacent to the northern extent of the Offsite Highways;
M40 J9, associated with Tritax development (for Siemens), and wider proposed (draft) allocations	Up to 56,162 sqm (GIA) of B2 floor space and ancillary uses (22/01114/F), and up to 163,337 sqm of B2 and B8 floor space (25/00284/F)	Approximately 7km south from the Main Site
Richborough Estates	up to 230 home residential development	Adjacent west to the Main Site

South of Chesterton and Lodge Farm (east of Tritax at J9)	Employment development South of Chesterton (9ha), and Lodge Farm 25ha	Around 6-7km from the site

11.7.2 The main potential cumulative impact would be potential loss of medium sensitivity mineral resource as many of the above sites also lie in Mineral Safeguarded Areas for limestone resource. It is assumed that all other sites in this Safeguarded area will also be required to respond to Core Strategy Policy M11, and consider the potential viability of their specific site resource, and of prior extraction of minerals either on a commercial basis, or as part of sustainable construction processes. Such actions across all sites would maximise the extent to which local mineral resource is used, and minimise the extent of sterilisation and in so doing, minimise any harm to the Minerals Core Strategy. Such actions cumulatively would also further reduce the transport impacts associated with the construction process. Based on a minor effect magnitude, the overall significance of effect would be minor adverse.

11.7.3 Land contamination issues on any sites are subject to the same national guidance and so all relevant developments must meet a common standard for safe development. This would include a requirement to undertake a phased investigation of the site including Phase 1 preliminary risk assessment, Phase 2 intrusive investigation remediation strategy, remediation implementation and verification in accordance with LCRM. In this context it is therefore considered that there will be no significant cumulative effects on ground conditions and contamination resulting from the Proposed Development and the cumulative schemes considered as part of the assessment, as each development will incorporate appropriate mitigation measures to have overall negligible effect significance.

11.8 SUMMARY AND CONCLUSIONS

11.8.1 This ES Chapter and technical appendices assess the potential effects of the Proposed Development on Ground Conditions and Land Contamination including Groundwater. It describes the methods used to assess the effects, the baseline conditions currently existing at the Application Site (Order Limits), the potential direct and indirect effects of the Proposed Development and the mitigation measures required to prevent, reduce or offset the potential effects and the residual effects.

11.8.2 The Main Site has predominantly remained undeveloped agricultural land with several farm buildings, a soil treatment facility, a water reservoir within its

boundary, as well as a historic landfill (Ardley Landfill) in the eastern corner where the proposed rail alignment for the southern Railfreight Terminal access is proposed. The wider Application Site also contains parts of the adjacent Ardley Cutting and Quarry SSSI.

11.8.3 The limestone deposits present onsite are considered to be the only significant resource of hard rock mineral with relevance to the Oxfordshire Minerals and Waste Core Strategy (2017). The Application Site forms one part of the wider 'Safeguarding Area', and amount of rock generated would outstrip demand in the Core Strategy plan period, and as set out in **ES Appendix 11.3** the economic need to the development is considered to exceed the need for the mineral from this specific site or location. The conservation and use of mineral resources will be guaranteed, as supported by the guidance within the Local Plan, by using all excavated minerals from the subject site on the development of the site whilst not putting additional demand on the existing mineral supply. Issues of policy compliance, and any policy harm, are addressed in the Planning Statement, but with regard to likely environmental impacts, the approach proposed would make use of a significant quantity of site-won material. It represents a sustainable approach to delivery of the OxSRFI scheme, and is likely to result in minor adverse impacts.

11.8.4 New Jurassic rock exposure will be created along the new rail alignment which is considered to be a benefit.

11.8.5 PFAS investigations completed in 2026 identified low concentrations of PFAS within surface water, sediment and limited groundwater locations across the Main Site (included at Appendix 11.11). The evidence indicates that the principal source is historic contamination associated with the former RAF Upper Heyford Airfield, with the Main Site acting primarily as a receptor and conveyance pathway. The concentrations identified are significantly lower than those reported elsewhere within the local catchment and are not considered to present a significant risk to human health or controlled waters. The existing contamination management framework, remediation strategy requirements and CEMP measures are considered appropriate to manage PFAS alongside other contaminants that may be encountered during construction.

11.8.6 Otherwise, no significant sources of soil or groundwater contamination or ground gases have been identified or are expected at the Main Site. Ardley Landfill contains high levels of hazardous ground gases which is subject to an existing gas management system. However, it is suggested this system is

adapted following earthworks proposed for relevant parts of the Application Site.

11.8.7 The CEMP (ES Appendix 2.3) provided embedded mitigation which sets the procedures to ensure that mobilisation of soils during the construction phase is minimised and outlines detailed methodologies to prevent adverse effects on or from ground conditions.

11.8.8 The assessment has been undertaken having regard to the presence of existing regulated waste management facilities and historic contamination sources within the wider study area. Environmental permitting controls, together with the proposed construction and operational mitigation measures, provide a robust framework for the management of contamination, landfill gas and controlled water risks. No significant residual effects relating to ground conditions, contamination or controlled waters are anticipated.

11.8.9 Overall, based on the assessment and investigations undertaken to date, it is considered that potential effects from the construction and operational phases of the development will be **minor adverse or negligible** and potential **minor beneficial** in the case of the Jurassic Rock exposure in the SSSI following the implementation of appropriate mitigation measures.