A428 Black Cat to Caxton Gibbet improvements

TR010044

Volume 6

6.1 Environmental Statement

Chapter 9: Geology and Soils

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

26 February 2021

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A428 Black Cat to Caxton Gibbet improvements

Development Consent Order 202[ ]

Chapter 9: Geology and Soils

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9 Geology and soils

9.1 Competent expert evidence

9.1.1 This chapter presents the results of an assessment of the likely effects of the Scheme on geology and soils – a collective term used to describe the geological and soil setting and features, including land contamination.

9.1.2 The competent expert responsible for the assessment is a Technical Director with AECOM who is a Chartered Engineer (CEng) and a full member of the Geological Society of London (BSc Hons Civil Engineering, MSc Hydrogeology, PhD Groundwater Modelling) MICE (CEng), AIEMA, FGS.

9.1.3 They have over 25 years of experience in providing technical expertise and input into Geological, Hydrogeological and Environmental Impact Assessments (EIA) for major infrastructure and linear projects including highways, airports, pipelines, quarries and mines.

9.2 Legislative and policy framework

9.2.1 The following legislation and planning policy are of direct relevance to geology and soils and have been considered as part of the assessment.

9.2.2 Compliance with statute and policy relating to geology, soils and contaminated land is addressed within the Case for the Scheme **[TR010044/APP/7.1]**.

Legislation

Water Framework Directive

9.2.3 *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy* (Ref 9-1) (Water Framework Directive (WFD)) makes provision for the maintenance and improvement of the 'ecological and chemical status' of the water environment, which includes surface water and groundwater bodies.

9.2.4 As the Scheme has the potential to impact catchments of WFD designated waterbodies – for example through the migration of contaminants – the requirements of the *WFD* (Ref 9-1) have been considered in the assessment.

Drinking Water Directive

9.2.5 *Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption* (Ref 9-2) (the *Drinking Water Directive*) is designed to ensure that drinking water quality is wholesome and clean. It also sets the approach to monitoring water quality and provides both greater access to water and information to citizens.

9.2.6 As the Scheme has the potential to impact on the quality of waters (i.e. both groundwater and surface waters) used for drinking water purposes - for example through remobilisation and or migration of contaminants during:

a. Excavations.

b. Dewatering.

c. Abstractions.

d. Accidental spillages of contaminants/chemicals into surface water bodies or aquifers during construction activities.

9.2.7 The requirement of the *Drinking Water Directive* has been considered in the assessment.

Environmental Protection Act 1990 and Part 2A (the Contaminated Land Regime)

9.2.8 Legislation relating to contaminated land in the UK is contained within Part 2A of the *Environmental Protection Act 1990* (Ref 9-3) (EPA), which was inserted by s57 of the *Environment Act 1995* (Ref 9-4) and by s86 of the *Water Act 2003* (Ref 9-5) and elaborated upon within *The Contaminated Land (England) Regulations 2006* (Ref 9-6) (as amended).

9.2.9 Part 2A of the *EPA* (Ref 9-3) provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment. Sites are identified as contaminated land if they are: causing harm, if there is a significant possibility of significant harm, or if the site is causing, or could cause, pollution of controlled waters (i.e. both surface and groundwater).

9.2.10 The content of the *EPA* (Ref 9-3) has been considered as part of the assessment of contaminated land.

Water Act 2003

9.2.11 The *Water Act 2003* (Ref 9-5) introduced a revision to the wording of the *EPA* (Ref 9-3), which requires that if a site is causing or could cause significant pollution of controlled waters, it may be determined as contaminated land.

9.2.12 Once a site is determined to be contaminated land then remediation is required to render significant pollutant linkages insignificant (i.e. the source-pathway-receptor relationships that are associated with significant harm to human health and/or significant pollution of controlled waters), subject to a test of reasonableness.

9.2.13 Aspects of the *Water Act 2003* (Ref 9-5) relating to contaminated land and pollution have been given regard in the assessment.

Water Resources Act 1991

9.2.14 The *Water Resources Act 1991* (Ref 9-7) is the primary piece of legislation for the protection of water resources. It aims to manage water resources and to prevent and minimise pollution of water by providing statutory protection for controlled waters (i.e. streams, rivers, canals, marine environment and groundwater), and makes it an offence to discharge to controlled waters without the permission or consent of the regulators of these areas.

9.2.15 Elements of the *Water Resources Act 1991* (Ref 9-7) relating to the control of pollution and abstraction of water resources have been reviewed as part of the assessment.

National Policy Statement for National Networks

9.2.16 The *National Policy Statement for National Networks* (NPSNN) (Ref 9-8) acknowledges that the construction and operation of road and rail infrastructure have the potential to affect geology and soils, and provides guidance on the identification, assessment and mitigation of effects on geology and soils.

9.2.17 The NPSNN (Ref 9-8) sets out a requirement to take into account the economic and other benefits of the best and most versatile (BMV) agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification (ALC)) and where possible poorer quality land in preference to that of a higher quality should be taken. It also describes the requirement to seek to minimise impacts on soil quality and citing, where possible, that developments should be on previously developed (brownfield) sites provided that they are not of high environmental value.

9.2.18 The NPSNN (Ref 9-8) requires the reporting of likely significant effects on designated sites of geological conservation importance, and sets out requirements for the consideration and assessment of land (in)stability.

9.2.19 With regard to the potential for land contamination associated with former or current land uses, the NPSNN (Ref 9-8) states that for developments on previously developed land, information regarding the risks posed by land contamination and how they will be mitigated is required.

9.2.20 The requirements of the NPSNN (Ref 9-8) in relation to assessing and mitigating the impacts of the Scheme on agricultural land, geological resources and potential land contamination have been taken account of in this assessment through a combination of desk studies and sampling through ground investigations, in order to identify the likely significant effects that the Secretary of State for Transport needs to give due regard to in decision-making.

Overarching National Policy Statement for Energy (EN-1)

9.2.21 The *Overarching National Policy Statement for Energy (EN-1)* (Ref 9-9Ref 9-10) sets out the Government's policy on energy and infrastructure development.

9.2.22 *EN-1* (Ref 9-9Ref 9-10) states that applicants should consider the effects on sites of geological conservation importance and should seek to minimise impacts on BMV land. It further states that applicants should ensure the risk posed by land contamination is also considered, as well as potential impacts on groundwater.

9.2.23 The requirements of *EN-1* (Ref 9-9) associated with the gas pipeline diversion within the Scheme have been accounted for in the assessment, in the manner described in paragraph 9.2.20.

National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)

9.2.24 The *National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)* (Ref 9-10) relates to gas supply and gas and oil pipelines and sits under *EN-1* (Ref 9-9).

9.2.25 *EN-4* (Ref 9-10) states that the construction of pipelines can impact on soil quality, interfere with groundwater flow pathways, mobilise contaminants in the ground and can require the removal and disposal of contaminated material. It also identifies that applicants should assess the stability of ground conditions associated with pipeline routes, using previous borehole data and geological information.

9.2.26 The requirements of *EN-4* (Ref 9-10) associated with the gas pipeline diversion within the Scheme have been accounted for in the assessment, in the manner described in paragraph 9.2.20.

National Planning Policy Framework

9.2.27 The *National Planning Policy Framework* (NPPF) (Ref 9-11) identifies that planning decisions should recognise that some undeveloped land can perform many functions, and that substantial weight should be given to the value of using suitable brownfield land (including supporting appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land).

9.2.28 The *NPPF* (Ref 9-11) also identifies that planning decisions should contribute to the conservation and enhancement of the natural environment.

9.2.29 In relation to agricultural land, the NPPF (Ref 9-11) acknowledges that where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality.

9.2.30 The *NPPF* (Ref 9-11) also details that planning decisions need to give regard to ground conditions and pollution, including any risks arising from land instability and contamination.

9.2.31 The requirements of the *NPPF* (Ref 9-11Ref 9-9) has been accounted for in the assessment by undertaking studies to establish the existing conditions of the geological and soils environment, including potential contamination sources, and how these conditions may be affected by (or influence) the Scheme.

Planning Practice Guidance

9.2.32 *Planning Practice Guidance for Land stability* (Ref 9-12) and *Land affected by contamination* (Ref 9-13) adds further context to the *NPPF* (Ref 9-11Ref 9-9) by advising on how to ensure that development is suitable to its ground conditions and how to avoid risks caused by unstable land, and provides guidance to address land affected by contamination.

9.2.33 Advice contained with *this guidance* (Ref 9-12; Ref 9-13) has been considered when undertaking studies to identify and assess potential sources of contamination, and to inform the assessment of ground conditions.

Local Policy

Huntingdonshire District Council

9.2.34 *Huntingdonshire's Local Plan to 2036* (Ref 9-14) was adopted by Huntingdonshire District Council on 15 May 2019 and contains the following policies of relevance to the assessment:

a. LP 10 – The countryside.

b. LP 15 – Surface water.

c. LP 30 – Biodiversity and geodiversity.

d. LP 37 – Ground contamination and groundwater pollution.

South Cambridgeshire District Council

9.2.35 The *South Cambridgeshire Local Plan 2018* (Ref 9-15) was adopted by South Cambridgeshire District Council on 27 September 2018 and contains the following policies of relevance to the assessment:

a. NH/3 – Protecting agricultural land.

b. NH/5 – Sites of biodiversity or geological importance.

c. SC/11 – Contaminated land.

d. CC/7 – Water quality.

Bedford Borough Council

9.2.36 The *Bedford Borough Local Plan 2030* (Ref 9-16) was adopted by Bedford Borough Council on 15 January 2020 and contains the following policies of relevance to the assessment:

a. 42S – Protecting biodiversity and geodiversity.

b. 46S – Use of previously developed land and use of undeveloped land.

c. 47S – Pollution, disturbance and contaminated land.

d. 50S – Water resources.

Central Bedfordshire Council

9.2.37 The *Central Bedfordshire Pre-submission Local Plan 2015 – 2035* (Ref 9-17) comprises Central Bedfordshire Council's draft local plan (dated January 2018) and is currently being examined by the Secretary of State for Transport. The following draft policies are of relevance to the assessment:

a. CC7 – Water quality.

b. CC8 – Pollution and land instability.

c. EE3 – Nature conservation.

d. DC5 – Agricultural land.

9.3 Assessment methodology

Scope of assessment

9.3.2 A scoping exercise was undertaken in mid-2019 to identify the matters to be covered by the geology and soils assessment and to agree the approach with the relevant statutory bodies.

9.3.3 The assessment scope was established at that time by comparing available design and landtake details for the Scheme with data, information and records relating to the geological and soil resources.

9.3.4 The scoping exercise was informed by the technical and reporting guidance contained in the *Design Manual for Roads and Bridges Volume 11: Environmental Assessment* (Ref 9-18) (DMRB) and *Interim Advice Note 125/15: Environmental Assessment Update* (Ref 9-19).

9.3.5 The outcomes of scoping were recorded in a scoping report (Ref 9-20), which was consulted upon as part of a formal request to the Inspectorate for a scoping opinion and included a summary of all assessment work undertaken as part of the design-development of the Scheme.

9.3.6 The Inspectorate's scoping opinion **[TR010044/APP/6.5]** identified a number of additional overarching EIA and topic-specific matters that were subsequently brought into the overall scope of the assessment. These further considerations are detailed in **Table 1** of **Appendix 4.3** of the Environmental Statement **[TR010044/APP/6.3]** and include a summary of how Highways England has responded to the points raised, and where this information is reported.

9.3.7 The Inspectorate agreed with Highways England that:

a. The operational impacts of the Scheme on geological and soil resources could be scoped out of the assessment as this phase would not involve ground disturbance, and therefore it would be unlikely to result in significant effects.

b. The operational impacts of the Scheme on human health could be scoped out of the assessment as the potential pathway for contamination from soils during this phase would be limited, and therefore it would be unlikely to result in significant effects.

c. Impacts on geology and soils are unlikely to occur during the future maintenance of the Scheme, and therefore future maintenance could be scoped out of the assessment.

9.3.8 Accordingly, the effects of the Scheme during the operational and maintenance phases have been scoped out of this assessment in agreement with the Planning Inspectorate and recorded within the scoping opinion for the Scheme **[TR010044/APP/6.5]**.

9.3.9 Subsequent to the publication of the scoping opinion **[TR010044/APP/6.5]** Highways England published a series of new DMRB standards relating to sustainability and the environment (Ref 9-21), resulting in the phased withdrawal of the guidance used to inform the *scoping exercise* (Ref 9-18; Ref 9-19) from July 2019.

9.3.10 A decision was made by Highways England to adopt the new DMRB standards (Ref 9-21) part way into the assessment process, the details of which are summarised in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**.

9.3.11 **Table 2** of **Appendix 4.3** of the Environmental Statement **[TR010044/APP/6.3]** sets out the changes to the scoping and methodology of the geology and soils assessment resulting from the adoption of the new DMRB standards (Ref 9-21).

9.3.12 In addition to the matters raised in the scoping opinion **[TR010044/APP/6.5]** and through the adoption of the new DMRB standards (Ref 9-21), the final assessment scope has also been shaped by the following:

a. The outcome of consultation and engagement with statutory bodies, non-statutory organisations and other stakeholders with an interest in the protection and conservation of geological interests and soil resources.

b. Design changes made to the form and extent of the Scheme and the area of land required for its construction, operation and maintenance (the Order Limits).

c. The outcomes of desk-studies and ground investigations in the field, to establish the baseline conditions.

9.3.13 The assessment has focused on identifying and reporting the likely impacts and effects of the Scheme on the following elements (receptors) of the geological and soils environment:

a. Effects from contamination on human health and controlled waters (comprising both surface water and groundwater) – both in relation to the potential effect of existing contamination on the Scheme, and the potential for the Scheme to result in contamination.

b. Effects on bedrock geology and superficial deposits – including geological designated sites of national and local importance.

c. Effects on soil resources – including BMV land used for agricultural purposes, and soils that may support ecologically designated sites and habitats.

Assessment standards and guidance

9.3.14 The following standards and guidance have been used to inform the scope and content of the assessment, and to assist the identification and mitigation of likely significant effects. This builds upon the overarching EIA methodology and guidance presented in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**.

Design Manual for Road and Bridges

9.3.15 The following DMRB standards has been applied in the assessment to identify the value and sensitivity of geological features, soil and water resources, historical and contemporary land uses, and public health, and to identify and evaluate the impacts and effects that construction of the Scheme would likely have on these interests:

a. *LA 104 Environmental assessment and monitoring* (Ref 9-22).

b. *LA 109 Geology and soils* (Ref 9-23).

9.3.16 Reference has also been made to the following DMRB standards in relation to the definition and application of assessment criteria for value (sensitivity) and magnitude of impact (change):

a. *LA 110 Material assets and waste* (Ref 9-24).

b. *LA 113 Road drainage and the water environment* (Ref 9-25).

Other guidance

9.3.17 Regard has been given to the following technical guidance as part of the assessment process and the identification and development of mitigation measures:

a. *BS 10175+A2:2017: Investigation of Potentially Contaminated Sites. Code of Practice* (Ref 9-26), published by the British Standards Institution.

b. *Land Contamination: Risk Management (LCRM)* (Ref 9-27), published by the Environment Agency.

c. *The Definition of Waste: Development Industry Code of Practice* (Version 2) (Ref 9-28), published by CL:AIRE (Contaminated Land: Applications in Real Environments).

d. *Guide to assessing development proposals on agricultural land* (Ref 9-29), published by Natural England.

e. *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites* (Ref 9-30), published by Defra (Department for Environment, Food and Rural Affairs).

Development of a Conceptual Site Model

9.3.18 The methodology applied considers the potential presence of land and groundwater contamination, sites of geological/geomorphological significance (such as geological conservation features or mineral resources), controlled waters, the built environment, human receptors and the presence of agricultural land/soils. Geotechnical constraints such as differential settlement, subsidence and the potential for explosive ground gas accumulation have also been considered where relevant, with the built environment identified as the main receptor including foundations, below ground structures, utilities equipment and any proposed buildings and structures associated with the Scheme.

9.3.19 Contaminated land is assessed through the identification and assessment of pollutant linkages (contaminant-pathway-receptor relationships). Implicit in the guidance is the application of risk assessment to assess whether potential significant pollutant linkages may be present.

9.3.20 The risk-based methodology adopted in the assessment has been based on Environment Agency guidance (Ref 9-27) and has relied on the development of a Conceptual Site Model (CSM).

9.3.21 The CSM comprises three components:

a. A source of contamination – for example historical site operations.

b. A pathway (a route by which receptors can become exposed to contaminants) – for example vapour inhalation, soil ingestion and groundwater migration.

c. A receptor (a target that may be exposed to contaminants via identified pathways) – for example human occupiers, surface water, groundwater, land and property or ecosystems.

9.3.22 For a potential environmental or human receptors risk to exist, a plausible pollutant linkage involving each of these components must exist. If one of the three components is absent then a pollutant linkage (and thereby potentially unacceptable risk) is unlikely to exist.

9.3.23 Where all three components are, or may be, present, a potentially complete pollutant linkage is considered to exist. The presence of a pollutant linkage does not necessarily imply that the risk is unacceptable; rather it means that further investigation of the potential pollutant linkages is necessary.

9.3.24 Human health and controlled waters risk assessments have been undertaken based on findings of site investigation works, samples and laboratory testing recorded during intrusive Ground Investigation (GI) undertaken in 2019–2020 to inform the design-development of the Scheme.

9.3.25 Geotechnical factors and constraints such as differential settlement, subsidence and the potential for explosive ground gas accumulation have also been considered in the development of the CSM, where relevant.

9.3.26 Further details of the CSM are presented in Section 9.6.

Establishment of the baseline conditions

9.3.27 Establishment of the baseline conditions has involved reference to existing data sources, consultation with statutory bodies, and fieldwork surveys.

Consultation

9.3.28 Details regarding the statutory consultation undertaken as part of the Scheme, and its outcomes in relation to geology and soils, are presented in the Consultation Report **[TR010044/APP/5.1]**.

9.3.29 Engagement has been undertaken with Natural England and the Environment Agency during the preparation of the assessment to obtain views on matters relating to impacts on soil resources and their mitigation/management, and to exchange information relating to the development of the CSM and aspects of the groundwater assessment (forming part of the geology and soils assessment).

9.3.30 The following information was shared with Natural England through a series of meetings, presentations and written correspondence:

a. The proposed scope of agricultural soil sampling surveys to verify soil grades (these were unable to be undertaken for reasons set out in Section 9.4).

b. The approach to how soil management and mitigation measures would be reported, including the consideration of relevant guidance.

9.3.31 The following information was shared with the Environment Agency through a series of meetings, presentations and written correspondence:

a. Data sources used in the assessment, including the findings of the *2019–2020 GI* (Ref 9-31).

b. The extents of the assessment study area and relevant features within it.

c. Geological information and groundwater data (for example flows, levels, quality and abstractions).

d. The scope of groundwater quality sampling and monitoring to be undertaken.

e. The sources, pathways and receptors considered within the CSM, including information on their potential linkages.

f. The preliminary findings of an assessment of construction impacts on groundwater.

g. Data requested from the Environment Agency on 10 January 2019 and 16 January 2019 (EAN/2018/110217), 2 May 2019 (EAN/2019/123609), 20 March 2020 (EAN/2020/162997) and 15 June 2020 (EAN/2020/170528).

9.3.32 Engagement with the Environment Agency identified a requirement to undertake groundwater and surface water sampling and monitoring at a number of locations to establish baseline groundwater and surface water quality conditions, the findings of which are reported in Section 9.6 and discussed in more details in **Chapter 13, Road drainage and the water environment [TR010044/APP/6.1]**.

9.3.33 Engagement with South Cambridgeshire District Council, Cambridge City Council, Huntingdonshire District Council, Bedford Borough Council and Central Bedfordshire Council was also undertaken to access private water abstraction/supply records held by the Councils.

9.3.34 Feedback obtained from this engagement has been considered when undertaking and reporting the assessment, as appropriate.

Ground Investigation (GI)

9.3.35 An intrusive *GI* (Ref 9-31) was undertaken between September 2019 – January 2020 to:

a. Obtain details of prevailing ground conditions and constraints associated with geology and soils.

b. Inform an assessment of risks to human health associated with potential contaminative sites.

c. Inform an assessment of risk to controlled waters.

d. Identify potential ground gas issues.

9.3.36 The GI comprised cable percussion and rotary cored holes, dynamic (windowless) sampler holes, trial pits, in-situ and laboratory chemical testing, and groundwater, surface water and ground gas monitoring.

9.3.37 A summary of the GI is presented in **Appendix 9.1** of the Environmental Statement **[TR010044/APP/6.3]**.

Desk studies and reports

9.3.38 Historical factual and interpretative geotechnical, geo-environmental and site investigation data and records contained within the following reports have been reviewed and reported to inform the establishment of the baseline conditions and the development of the CSM:

a. *Landmark Envirocheck Reports* obtained for the Scheme in both 2017 (Ref 9-32) and 2019 (Ref 9-33) to identify potential sources of contamination, previous industrial land uses and sensitive land uses.

b. *Information taken from the 2017 Preliminary Sources Study Report (PSSR)* (Ref 9-34), prepared by Jacobs Stage 2 Supplier).

c. *Information taken from the 2020 PSSR* (Ref 9-35), prepared by AECOM.

d. *Ground Investigation Report* (Ref 9-31), prepared by AECOM.

9.3.39 In addition, information and records were obtained from the following organisations and sources:

a. *British Geological Survey (BGS) 1:50,000 Scale Mapping – Sheet 187 (Huntingdon) (Ref 9-36) and Sheet 204* (Biggleswade) (Ref 9-37).

b. *BGS Hydrogeology Map 1:100,000 scale – Hydrogeology of the area between Cambridge and Maidenhead* (Ref 9-38).

c. *Zetica unexploded ordnance (UXO) risk mapping* (Ref 9-39).

d. *Borehole information and records available on the BGS Interactive Online Borehole Log Viewer* (Geoindex) (Ref 9-40).

e. Information on Local Geological Sites (LGS) (formerly known as Regionally Important Geological Sites (RIGS)) held by the Cambridgeshire Geological Society (Ref 9-41) and the Bedfordshire Geology Group (Ref 9-42).

f. *Environmental data available on the Environment Agency's website* (Ref 9-43).

g. *Environmental data contained within the MAGIC online mapping* (Ref 9-44).

h. *The Coal Authority online interactive maps* (Ref 9-45).

i. Information on controlled waters, reported in **Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.1]**.

j. Information on ecologically designated sites, reported in **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**.

9.3.40 The Agricultural Land Classification (ALC) system provides a method for assessing the quality of farmland and classifies land into grades. These grades are defined in Natural England's *Technical Information Note TIN 049* (Ref 9-46) and in summary comprise the following:

a. Land with Grades 1, 2 and 3a is classed as BMV and comprises land that is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses.

b. Land within Grade 3b is not classed as BMV as it is only capable of producing a moderate yield of a narrow range of crops.

c. Land within Grades 4 and 5 is not classed as BMV as it comprises land with limitations that restrict the growth of crops.

9.3.41 To establish the extent and distribution of ALC grades, information was obtained from Natural England's *East Region: 1:250,000 Series Agricultural Land Classification* map (Ref 9-47).

9.3.42 Soil data (Ref 9-48) compiled by the Cranfield Soil and Agri-food Institute was obtained to establish the coverage, extent and variation of different soil types.

9.3.43 Information relating to existing soil grades and profiles was supplemented by soil sampling and chemical analysis undertaken as part of the *GI* (Ref 9-31).

Value (sensitivity) of the receptor

9.3.44 The value of geological and soil receptors has been established using the criteria contained in *LA 109* (Ref 9-23), and where relevant criteria contained in *LA 113* (Ref 9-25), as reproduced in **Table 9-1**. The definition of receptor value has taken into consideration any surrounding land uses (based on mapping, site visits and investigations, and presence of planning designations).

Table 9-1: Receptor value (sensitivity) criteria

Receptor value (sensitivity)	Geology	Soils***	Contamination
Very High	Geology: very rare and of international importance with no potential for replacement (e.g. UNESCO World Heritage Sites, UNESCO Global Geoparks, SSSI's and GCR where citations indicate features of international importance). Geology: meeting international designation citation criteria which is not designated as such.	Soils directly supporting an EU designated site (e.g. SAC, SPA, Ramsar). ALC Grades 1 & 2.	Human health: very high sensitivity land use such as residential or allotments. Surface water: use relevant sensitivity criteria from Table 3.70 in *LA 113* (Ref 9-25). Groundwater: use sensitivity criteria in *LA 113* (Ref 9-25).
High	Geology: rare and of national importance with little potential for replacement (e.g. geological SSSI, ASSI, National Nature Reserves (NNR)). Geology: meeting national designation citation criteria which is not designated as such.	Soils directly supporting a UK designated site (e.g. SSSI). ALC Grade 3a.	Human health: high sensitivity land use such as public open space. Surface water: use relevant sensitivity criteria from Table 3.70 in *LA 113* (Ref 9-25). Groundwater: use sensitivity criteria in *LA 113* (Ref 9-25).
Medium	Geology: of regional importance with limited potential for replacement (e.g. LGS). Geology: meeting regional designation citation criteria which is not designated as such.	Soils supporting non-statutory designated sites (e.g. Local Nature Reserves (LNR), LGSs, Sites of Nature Conservation Importance (SNCIs)). ALC Grade 3b.	Human health: medium sensitivity land use such as commercial or industrial; Surface water: use relevant sensitivity criteria from Table 3.70 in *LA 113* (Ref 9-25). Groundwater: use sensitivity criteria in *LA 113* (Ref 9-25).

Receptor value (sensitivity)	Geology	Soils***	Contamination
Low	Geology: of local importance / interest with potential for replacement (e.g. non designated geological exposures, former quarries / mining sites).	ALC Grades 4 & 5. Soils supporting non-designated notable or priority habitats.	Human health: low sensitivity land use such as highways and rail. Surface water: use relevant sensitivity criteria from Table 3.70 in *LA 113* (Ref 9-25). Groundwater: use sensitivity criteria in *LA 113* (Ref 9-25).
Negligible	No geological exposures, little / no local interest.	Previously developed land formerly in 'hard uses' with little potential to return to agriculture.	Human health: undeveloped surplus land / no sensitive land use proposed. Surface water: use relevant sensitivity criteria from Table 3.70 in *LA 113* (Ref 9-25). Groundwater: use sensitivity criteria in *LA 113* (Ref 9-25).

* As the *East Region: 1:250,000 Series Agricultural Land Classification* map (Ref 9-47) does not distinguish between ALC subgrades 3a and 3b, all land within ALC Grade 3 has been deemed to be BMV in the assessment.

** Soils not categorised as BMV can be allocated in a higher sensitivity category where particular agricultural practices contribute to the quality and character of the environment or the local economy.

Magnitude of impact criteria

9.3.45 The magnitude of impact (change) on geological and soil receptors has been established using the criteria contained in *LA 109* (Ref 9-23), and where relevant criteria contained in *LA 110* (Ref 9-24) and *LA 113* (Ref 9-25), as reproduced in **Table 9-2**.

9.3.46 The descriptors within **Table 9-2** for soil impacts of major and moderate magnitude have been supplemented with additional criteria contained in the *England National Application Annex to LA 109* (Ref 9-23) to enable the permanent loss or sealing of agricultural land to be quantified within the assessment.

9.3.47 The assignment of impact magnitude has taken into account the potential pathways through which an impact source / hazard may affect identified receptors.

Table 9-2: Magnitude of impact (change) criteria

Magnitude of impact (change)	Geology	Soils	Contamination
Major	Loss of geological feature / designation and/or quality and integrity, severe damage to key characteristics, features or elements.	Physical removal or permanent sealing of >20 ha of agricultural land.	Human health: significant contamination identified. Contamination levels significantly exceed background levels and relevant screening criteria (e.g. category 4 screening levels) SP1010 (Ref 9-24) with potential for significant harm to human health. Contamination heavily restricts future use of land. Surface water: use sensitivity criteria *in LA 113* (Ref 9-25). Groundwater: use sensitivity criteria *LA 113* (Ref 9-25).
Moderate	Partial loss of geological feature / designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.	Physical removal or permanent sealing of 1 ha to 20 ha of agricultural land. Permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).	Human health: contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria (e.g. category 4 screening levels) SP1010 (Ref 9-24). Significant contamination can be present. Control / remediation measures are required to reduce risks to human health / make land suitable for intended use. Surface water: use sensitivity criteria *in LA 113* (Ref 9-25). Groundwater: use sensitivity criteria *LA 113* (Ref 9-25).
Minor	Minor measurable change in geological feature / designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.	Temporary loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).	Human health: contaminant concentrations are below relevant screening criteria (e.g. category 4 screening levels) SP1010 (Ref 9-24). Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health. Surface water: use sensitivity criteria *in LA 113* (Ref 9-25). Groundwater: use sensitivity criteria *LA 113* (Ref 9-25).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements	No discernible loss / reduction of soil function(s) that restrict	Human health: contaminant concentrations substantially below levels outlined in relevant screening criteria (e.g. category 4 screening levels) SP1010 (Ref 9-24). No requirement for control

Magnitude of impact (change)	Geology	Soils	Contamination
	of geological feature / designation. Overall integrity of resource not affected.	current or approved future use.	measures to reduce risks to human health / make land suitable for intended use. Surface water: use sensitivity criteria *in LA 113* (Ref 9-25). Groundwater: use sensitivity criteria *LA 113* (Ref 9-25).
No Change	No temporary or permanent loss / disturbance of characteristics features or elements.	No loss / reduction of soil function(s) that restrict current or approved future use.	Human health: reported contaminant concentrations below background levels. Surface water: use sensitivity criteria *in LA 113* (Ref 9-25). Groundwater: use sensitivity criteria *LA 113* (Ref 9-25).

Significance of effect

9.3.48 The assignment of significance effects involved combining the value of the receptor with the predicted magnitude of impact, guided by the significance matrix set out in *LA 104* (Ref 9-22) (reproduced in **Table 9-3**).

Table 9-3: Significance matrix

		Magnitude of Impact				
		No Change	Negligible	Minor	Moderate	Major
Sensitivity of Receptor / Resource	Very High	Neutral	Slight	Moderate or large	Large or very large	Very large
	High	Neutral	Slight	Slight or moderate	Moderate or large	Large or very large
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
	Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

9.3.49 Where the significance of an effect is represented by two descriptors, for example large/very large within the matrix, professional judgement has been used to determine which of the significance descriptors applies to the effect being assessed.

9.3.50 Significant effects comprise those effects that are within the moderate, large or very large categories, in accordance with *LA 104* (Ref 9-22).

9.4 Assessment assumptions and limitations

Scheme design and limits of deviation

9.4.2 The assessment is based on the Scheme description presented in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]** and has taken into account the lateral (horizontal) limits of deviation illustrated on the Works Plans **[TR010044/APP/2.3]**, and the vertical limits of deviation stated in the Development Consent Order **[TR010044/APP/3.1]**, in order to establish a realistic worst case assessment scenario.

9.4.3 This scenario has identified and reported the effects that any lateral and/or vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components of the Scheme to be positioned at a slightly higher elevation, or brought into closer proximity to receptors, and thereby potentially result in different effects.

9.4.4 Notwithstanding any potential deviation, all embedded and essential mitigation measures would remain deliverable within the extents of the limits of deviation.

Baseline data and intrusive surveys

9.4.5 The assessment has been undertaken with reference to the baseline data, information and records pertaining to the geological and soils environment derived from desk-based sources and the *GI* (Ref 9-31). As the assessment relies on the interpretation of some third-party data and reports, it has been assumed that such information is accurate and a true reflection of the conditions it describes.

9.4.6 An agricultural survey involving auger samples to confirm ALC grades within the Order Limits was incorporated into the scope of the assessment. This survey was planned to be undertaken in 2020 during the design-development of the Scheme; however, as the timing of the survey coincided with the Covid-19 pandemic and associated lockdown restrictions, it was not possible to carry out the fieldwork[1]. Accordingly, the assessment of ALC grades has necessarily relied upon the following information sources:

a. Natural England's *East Region: 1:250,000 Series Agricultural Land Classification* map (Ref 9-47).

b. Soil information gathered as part of borehole samples taken during the *GI* (Ref 9-31).

9.5 Study area

9.5.1 Study areas have been defined based on the type of receptor being assessed and the area over which potential impacts are likely to occur.

[1] Subject to the timing of any lifting of lockdown restrictions in 2021, the agricultural survey will be undertaken. On completion of this fieldwork and analysis of the findings, a report will be prepared by Highways England and submitted to the Examination as further environmental information. Any requirement to update the assessment of effects on soil resources reported within this chapter will also be evaluated at that time, and if required, a supplementary report or addendum will also be submitted to the Examination.

9.5.2 The following areas have been adopted in the assessment, the extents of which have been informed by a combination of professional judgement, established industry practice and a review of the areas presented in the scoping report (Ref 9-20):

a. The study area for the assessment of construction impacts on soils comprises the area of land within the Order Limits. This is the area over which the Scheme is likely to interface with existing soil resources both temporarily and permanently.

b. The study area for the assessment of construction impacts on human health associated with contamination, impacts on geology, and impacts on statutory and non-statutory geological and ecologically designated sites, comprises the Order Limits and land extending outward to a distance of 500 metres from these limits (is defined as the Geology Study Area). This area is deemed appropriate for the consideration of historical and current potentially contaminative land uses, and geological interests, within and surrounding the Order Limits.

c. The study area for the assessment of construction impacts relating to contamination of controlled waters (i.e. groundwater and surface water bodies) and potable/non-potable (spray irrigation licences) water abstractions comprises the Order Limits and land extending outward to a distance of 1 kilometre (0.6 miles) (is defined as the Extended Geology Study Area). This area aligns with study areas adopted in **Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.1]** and has enabled consideration of possible migration pathways over longer distances from the Order Limits.

9.5.3 The extents of the Order Limits, the Geology Study Area and the Extended Geology Study Area are illustrated in **Figure 9.1** of the Environmental Statement **[TR010044/APP/6.2].**

9.6 Baseline conditions

9.6.1 The following sections describe the baseline conditions of geology, soils and contamination within the adopted study areas.

9.6.2 Reference is made in the description to:

a. Surface water and groundwater features presented in **Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.1]**.

b. Ecologically designated sites presented in **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**.

c. Sites and features located beyond the Extended Geology Study Area (only to the extent that these provide context to the features and interests within the adopted study areas).

Topography and land use

9.6.3 Land within the Order Limits is characterised by varying landform. Local topography at the existing Black Cat roundabout, the A1 and the western extents of the existing A428 in the Wyboston locality is relatively flat and situated around 20 – 30 metres Above Ordnance Datum (AOD), before rising gradually to around 40 metres AOD near the settlement of Great Barford to the east. East of St Neots, the topographical profile rises in elevation before reaching 65 metres AOD surrounding the existing Caxton Gibbet roundabout.

9.6.4 The principal land use within the Order Limits comprises agricultural land.

Designated geological sites

9.6.5 There are no geological SSSIs located within the Geology Study Area.

9.6.6 The nearest geological SSSI is the Weaveley and Sand Woods SSSI, located approximately 2.5 kilometres (1.55 miles) south of the Order Limits, as illustrated on **Figure 9.2** of the Environmental Statement **[TR010044/APP/6.2]**.

9.6.7 Information obtained from the Cambridgeshire Geological Society and the Bedfordshire Geology Group websites (Ref 9-41; Ref 9-42) confirms no Local Geological Sites (LGSs) are located within the Geology Study Area.

Made ground

9.6.8 Information contained in the BGS GeoIndex (Ref 9-40) provides only very limited details of made ground (described as artificial ground) in the Extended Geology Study Area, with none underlying the Order Limits.

9.6.9 Two areas described as ‘Artificial Ground’ and ‘Worked Ground – Void’ relating to former landfills and quarry sites are located on the western bank of the River Great Ouse in the Wyboston Leisure Park Area and Wyboston Lake Area. These are located approximately 0.9 kilometres (0.6 miles) and 1.2 kilometres (0.7 miles) north-east of the existing Black Cat roundabout respectively. These previously worked areas have subsequently been restored as lakes and pond features used for leisure activities.

9.6.10 Made Ground identified as part of the *GI* (Ref 9-31) was recorded at the following locations within the Order Limits: Roxton Road; the existing Black Cat roundabout and the A1 to the north and south of the junction; Barford Road, the East Coast Mainline (ECML) Railway; Potton Road; Toseland Road; North East Farm; Pillar Plantation; Eltisley Road junction; and the existing Caxton Gibbet roundabout. Made Ground described as “Quarry Backfill” comprising materials predominantly loose orange brown clayey gravelly sand or sandy gravel was also recorded in the Breedon Quarry area near the existing Black Cat roundabout, in the western part of the Order Limits.

9.6.11 Further details of the Made Ground identified during the *GI* (Ref 9-31) at these locations are presented in the Ground Investigation Summary Report within **Appendix 9.1** of the Environmental Statement **[TR010044/APP/6.3].**

Geological setting

9.6.12 The superficial deposits underlying the Order Limits comprise Diamicton (Glacial Till - Oadby Member), as well as Alluvium, River Terrace Deposits associated with the floodplain and fluvial channel of the River Great Ouse and its tributaries.

9.6.13 The bedrock underlying the superficial deposits consists entirely of Jurassic age sedimentary strata, generally dipping to the south.

9.6.14 There are no physical outcrops of the bedrock within the Geology Study Area.

Superficial geology

9.6.15 Superficial geology is illustrated on **Figure 9.1** of the Environmental Statement **[TR010044/APP/6.2]**.

9.6.16 The Oadby Formation (Glacial Till) is the primary superficial deposit, immediately underlying the central and eastern parts of the Geology Study Area. This deposit is present across the Geology Study Area, with the exception of an area around the railway crossing in the western part of the Order Limit around the flood plain of the River Great Ouse. Lithologically, the formation is described by the BGS (Ref 9-40) as '*grey, weathering brown Diamicton with subordinate lenses of sand and gravel, clay and silt*'.

9.6.17 *GI data* (Ref 9-31) and *published borehole logs* (Ref 9-40) indicates that the thickness of the Glacial Till across the Geology Study Area varies significantly from approximately 0.2 metres and 30 metres, with an average thickness of 5.2 metres. The vast majority of the Glacial Till is cohesive, with just a small fraction of the stratum comprising granular material.

9.6.18 The main valley of the River Great Ouse is underlain by Alluvium, which is locally described by the BGS (Ref 9-40) as '*pale brown, chalky, clean, coarse sand*' and 'small chalky gravel with ochreous flint'.

9.6.19 Borehole logs from the *GI* (Ref 9-31) indicated the thickness generally ranges between 0.4 metres and 3.5 metres. A thickness of 3 metres was recorded in a *published borehole log (BGS borehole log TL15NE2)* (Ref 9-40) located in the Wyboston area.

9.6.20 The wider floodplain of the River Great Ouse and the western extent of the Geology Study Area are underlain by the River Terrace Deposits bordering the Alluvium in the river valleys. BGS borehole log TL15NE101 (Ref 9-40) indicates that this deposit comprises '*very dense, orange brown, flint rich, angular-to-sub angular, fine-to-coarse gravel with much silty, fine-to-coarse sand*' and varies in thickness of between 0.1 metres and 14.6 metres. The River Terrace Deposits overlie the Oadby Formation.

9.6.21 According to *BGS mapping* (Ref 9-40) a small outcrop of Glaciofluvial deposits, comprising sand and gravel deposits is present in the vicinity the Little Barford village. However, it is considered unlikely that this stratum will be encountered during the works.

9.6.22 There is limited presence of Head deposits underlying a series of northerly flowing brooks within the central parts of the Geology Study Area. It is expected that these deposits are very limited in thickness and extent, and comprise clays, silts, sands and gravels.

Bedrock geology

9.6.23 Solid geology is illustrated on **Figure 9.2** of the Environmental Statement **[TR010044/APP/6.2]**.

9.6.24 The entirety of the Geology Study Area is underlain by clay-rich bedrock of Jurassic age comprising undifferentiated mudstone of the Oxford Clay (Peterborough Member) over the Kellaways Formation in the western/central area. In the east, stratigraphically, the bedrock comprises undifferentiated mudstone of the West Walton, Ampthill, Kimmeridge and Oxford Clay Formations over the Kellaways Formation.

9.6.25 *Published borehole logs* available from Geoindex (Ref 9-40) describe the Oxford Clay (Peterborough Member) as comprising '*very stiff, dark grey, green, indistinctly thinly laminated clay, with scattered fossil debris'* with a thickness varying from approximately 0.1 metres to 30 metres. The full thicknesses of the bedrock formations generally have not been proven in the area; however, a thickness of up to 30 metres was proven for the Oxford Clay in some of the *GI boreholes* (Ref 9-31) that fully penetrated the Oxford Clay into the underlying Kellaways Formation and the Cornbrash Limestone beneath it.

9.6.26 The undifferentiated units of the West Walton, Ampthill and Kimmeridge Clay Formations are lithologically described as '*stiff, bluish grey, brown and black clay with sub rounded-to-rounded, medium-to-coarse, gravel of chalk, fragments of siltstone and some flints*' by the BGS (Ref 9-40).

9.6.27 Underlying the Oxford Clay formation at depth is the Kellaways Formation. Lithologically, this unit is described by the BGS (Ref 9-40) as '*grey, variably compacted silicate-sandstone (sand) or sandy mudstone (clay) with calcareous shell fragments'* becoming '*dark grey, compacted clay-rock with shells'* at depth. *Published BGS borehole log TL15NE2* (Ref 9-40) indicates a thickness of approximately 5.4 metres in the western area of the Scheme. *GI boreholes* (Ref 9-31) indicated a thickness of up to 5.0 metres beneath the Order Limits.

9.6.28 The surface of the underlying Cornbrash Limestone was encountered during the GI in eight boreholes undertaken around the Black Cat Roundabout at depths of between 24.4m BGL and 29.8m BGL. It was mainly found immediately beneath the Kellaways Clay, although in two boreholes it was proved directly below the Kellaways Sand and in one borehole directly below the Oxford Clay. Chiselling only penetrated up to 0.3m of the stratum and the full thickness was not proven in any of the holes. It was typically described as extremely weak to moderately strong grey limestone, occasionally described as being thinly bedded and medium-grained.

Geological stratigraphy

9.6.29 A summary of the geological stratigraphy within the Geology Study Area is presented in **Table 9-4**.

Table 9-4: Geological stratigraphy in the Geology Study Area

Strata	Geological name	Lithological description	Approximate thickness (m)	Location within the Geology Study Area
Topsoil	Not Applicable	Freely draining, slightly acid, loamy soils Loamy and clayey floodplain soils with naturally high groundwater Lime-rich loamy and clayey soils with impeded drainage	0.3 – 4	Isolated voids in River Great Ouse floodplain.
Made Ground	Not Applicable	Variable materials comprising soft to stiff, brown, greyish and reddish-brown sandy, gravelly clay, and gravelly silt with fragments of brick, flint, chalk, mudstone, ceramic, concrete, wood, plastic and tarmac	0.2 – 4.0	Pocket across the Geology Study Area
Superficial Deposits	Alluvium	Pale brown, chalky, clean, coarse sand and small chalky gravel with ochreous flint.	0.4 – 4	Present predominantly in the River Great Ouse floodplain.
	River Terrace Deposits	Very dense, orange brown, flint rich, angular to sub angular, fine to coarse gravel with much silty, fine-to-coarse sand.	0.1 – 15	
	Glaciofluvial Deposits	Sand and gravel.	1 – 4 (estimated)	Unlikely to be encountered in the Geology Study Area.
	Oadby Member (Glacial Till Formation)	Grey, weathering brown Diamicton with subordinate lenses of sand and gravel, clay and silt.	0.2 – 30	Present across the majority Geology Study Area.

Strata	Geological name	Lithological description	Approximate thickness (m)	Location within the Geology Study Area
Bedrock Geology	West Walton, Ampthill Clay and Kimmeridge Clay Formations (Undifferentiated)	Stiff, bluish grey, brown and black clay with sub-rounded-to-rounded, medium-to-coarse, gravel of chalk, fragments of siltstone and some flint.	25 – 50	Not proved by the GI works.
	Oxford Clay Formation (Peterborough Member)	Very stiff, dark grey, green, indistinctly thinly laminated clay, with scattered fossil debris.	14 – 70	Present beneath much of the central and western parts of the study areas.
	Kellaways Formation	Grey, variably compacted sand and clay with calcareous shell fragments becoming dark grey, compacted clay-rock with shells.	2 – 6	Not outcropping at surface.
Bedrock Geology	Cornbrash Limestone	Extremely weak to moderately strong grey limestone, occasionally described as being thinly bedded and medium-grained	0.05* – 0.3*	Not outcropping at surface.
**Full Thickness not proven.*				

Unexploded Ordnance (UXO)

9.6.30 The UXO risk maps for Cambridgeshire and Bedfordshire from Zetica indicates that the Order Limits fall within a low-risk zone, which equates to an area of up to 10 bombs per 1000 acres. However, the *ground investigation report* (Ref 9-31) also identified that the Scheme lies within an area of low risk, therefore no further assessment was deemed necessary at this stage.

Ground conditions encountered during the Ground Investigation

9.6.31 Geotechnical testing was undertaken as part of the *GI* (Ref 9-31) on soil samples taken from boreholes, trial pits and window samples at depths up to 14 metres BGL.

9.6.32 The exploratory holes encountered a variable thickness of topsoil and/or made ground overlying natural superficial deposits of alluvium, river terrace deposits, glacial till and glaciofluvial deposits, overlying the bedrock geology comprising the Oxford Clay Formation and Kellaways Formation. The succession encountered in the exploratory holes confirmed the geology with slightly varying thicknesses of the formations:

a. Highly variable Made Ground comprising gravel of brick and concrete up to a maximum depth of 3.9 metres BGL, with recorded thickness of between 0.2 – 4.0 metres.

b. Superficial deposits comprising Alluvium with thickness of between 0.4 – 3.5 metres.

c. Glacial Till with thickness of between 0.2 – 30 metres.

d. River Terrace Deposits with thickness of between 0.1 – 14.6 metres.

e. Oxford Clay with thickness of between 0.1 – 30 metres.

f. Kellaways with thickness of between 0.1 – 5.0 metres.

g. Cornbrash Limestone with thickness (full thickness not proven) of between 0.05 – 0.3 metres

9.6.33 A summary of the GI is presented in **Appendix 9.1** of the Environmental Statement **[TR010044/APP/6.3]**.

Quarries and historic landfill sites

9.6.34 Within the Geology Study Area there are nine historical landfill sites concentrated around the village of Wyboston and the Wyboston Leisure Park area, a number of which are presumed to have developed from abandoned historical quarry sites.

9.6.35 Other former quarries in the Wyboston area have been restored as wetland / pond features.

9.6.36 Black Cat Quarry (Breedon Quarry), located immediately adjacent to the existing Black Cat roundabout, is undergoing a programme of restoration to agricultural and nature conservation uses in line with planning conditions attached to an existing planning consent. The quarry operations previously targeted the River Terrace deposits for sand and gravel extraction.

9.6.37 Information relating to mineral resources is presented within the assessment of Material Assets and Waste, reported in **Chapter 10, Material assets and waste** of the Environmental Assessment **[TR010044/APP/6.1]** and **Appendix 10.1** of the Environmental Statement **[TR010044/APP/6.3]**.

Land stability

9.6.38 The superficial and bedrock geology beneath the Geology Study Area have no viable coal bearing material; therefore, the area is not affected by historical coal mining.

9.6.39 Information within the *Envirocheck Report 2019* (Ref 9-33) indicates that ground stability hazards may exist within the Geology Study Area. These hazards, including their potential, are presented in **Table 9-5**.

Table 9-5: British Geological Survey ground stability ratings

Location	Envirocheck slice*	Potential for collapsible ground	Potential for compressible ground	Potential for ground dissolution	Potential for landslide	Potential for running sand	Potential for shrinking or swelling clay
Black Cat to Croxton	A (Ch. 0 – 2100)	Very Low	Very Low	No Hazard	Very Low	Very Low	Very Low
	B (Ch. 2100 – 4910)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	C (Ch.4910 – 5690)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Moderate
	D	Very Low	Low	No Hazard	Very Low	Low	No Hazard
	E	Very Low	No Hazard	No Hazard	Very Low	Very Low	Moderate
	F (Ch. 5690 – 8580)	Very Low	Very Low	No Hazard	Very Low	Very Low	Low
	G (Ch. 8580 – 10290)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	H (Ch. 10290 – 13090)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low

Location	Envirocheck slice*	Potential for collapsible ground	Potential for compressible ground	Potential for ground dissolution	Potential for landslide	Potential for running sand	Potential for shrinking or swelling clay
	Summary	Very Low	No Hazard to Low	No Hazard	Very Low	Very Low to Low	No Hazard to Moderate
Croxton to Caxton Gibbet	A2 (Ch.9140 – 12025)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	B2 (Ch.12025 – 14790)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	C2 (Ch.14790 – 17565)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	D2 (Ch.17565 – 19250)	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low
	Summary	Very Low	No Hazard	No Hazard	Very Low	Very Low	Low

* A slice refers to the way the *Envirocheck Report 2019* (Ref 9-33) has broken down the Geology Study Area along the chainage of the new dual carriageway. Each slice represents a 1:10,000 plot area (i.e. 2.7km x 2.7km) of the Geology Study Area.

Note: The hazard potential for each slice is an average of each location within the slice.

Ecologically designated sites

EU and UK designated sites

9.6.40 No EU (European Sites) or UK designated sites of ecological importance are located within the Geology Study Area.

Non-statutory designated sites

9.6.41 Non-statutory designed sites of ecological importance present within the Geology Study Area are detailed in **Table 9-6**:

Table 9-6: Non-statutory designated sites within the Geology Study Area

Site name and county	Relationship to the Order Limits	Biodiversity designation	Reason for designation
Croxton Park, Cambridgeshire	Immediately adjacent	County Wildlife Site (CWS)	Parkland, species rich grassland, nationally scarce plants and field margins with veteran trees.
Protected Road Verge – Elsworth (A428 to Common Farm), Cambridgeshire	Immediately adjacent, to the east of Caxton Gibbet	Protected Road Verge	Neutral/ calcareous grassland, presence of a local red data book species.
River Great Ouse, Bedfordshire	The Order Limits crosses the site	CWS	A major river not grossly modified by canalisation or poor water quality; supports >0.5 ha NVC S6 swamp; >0.5 ha S4 swamp; >0.05 ha. MG13 grassland; a Nationally Scarce vascular plant Fringed Water-lily (*Nymphoides peltate*) and a breeding population of the Nationally Rare Scarce Chase dragonfly (*Libellula fulva*).
Wyboston Pits, Bedfordshire	0.4km east	CWS	A wetland site, the main feature being water-filled excavations in the River Great Ouse floodplain with associated willow trees (*Salix* species), Common Fleabane (*Pulicaria dysenterica*) and Marsh Woundwort (*Stachys palustris*) with a number of dragonfly and damselfly species and warblers.
Rivers Ivel and Hiz, Bedfordshire	0.07km south	CWS	The river system including adjacent habitats and features. There is a population of Water Vole (*Arvicola amphibius*)
Sir John's Wood, Bedfordshire	0.19km east	CWS and Ancient Woodland	Ancient semi-natural woodland

Site name and county	Relationship to the Order Limits	Biodiversity designation	Reason for designation
Zwetsloots Pits, Bedfordshire	0.20km south	CWS	Open water and marshy grassland (floodplain grazing marsh) habitat and marsh habitat
Begwary Brook Pits, Bedfordshire	0.20km south	CWS and Wildlife Trust	Mosaic of fen, marsh and swamp, river and stream with standing open water

9.6.42 Further details relating to these non-statutory designated sites are presented in **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**.

Soils

Agricultural Land Classification

9.6.43 A review of the distribution of soils within the Order Limits (Ref 9-47) shows that ALC Grade 2 quality agricultural soils account for nearly 82% of the land within the Order Limits.

9.6.44 ALC Grade 2 soils extend from the Alington Hill locality through to the existing Caxton Gibbet roundabout. A smaller pocket of ALC Grade 2 soils is located immediately east of the River Great Ouse, extending eastward towards the ECML Railway. Further ALC Grade 2 soils surround the existing A421 to the west of Roxton, around the A1 south of Church End, and around the A1 at Wyboston interchange.

9.6.45 ALC Grade 3 soils within the Order Limits extend from Alington Hill to the west of the ECML Railway. A further narrow area of ALC Grade 3 soils is located immediately west of the River Great Ouse, extending southwards towards Tempsford.

9.6.46 The area of the Order Limits containing and surrounding the existing Black Cat roundabout contains ALC Grade 1 soils which extend northwards as far as Chawston and southwards to the east of Roxton.

9.6.47 The distribution of ALC grades within the Order Limits is illustrated on **Figure 9.3** of the Environmental Statement **[TR010044/APP/6.2]**, and presented by type in **Table 9-7**.

Table 9-7: Distribution of ALC grades within the Order Limits

Grade	BMV	Description	Area (ha)	Percentage (%) of area within the Order Limits	GI sampling observations
ALC Grade 1	Yes	Excellent	52.77	10.3	GI logs describe these soils as dark brown slightly gravelly clay and sand.
ALC Grade 2	Yes	Very Good	411.75	80.2	GI logs describe these soils as soft brown to firm dark brown sandy gravelly Clay with frequent rootlets (<1mm).
ALC Grade 3	Yes	Good to Moderate	47.36	9.2	GI logs describe these soils as soft brown to firm dark brown sandy gravelly sands with Clay inclusions and frequent rootlets (<2-3mm).
ALC Grade 4	No	Poor	0.46	0.1	There are no GI logs in this area.
Non-Agricultural	-	Other land primarily in non-agricultural use	1.27	0.2	There are no GI logs in this area.
Total Agricultural Land =			**513.61**	**100**	

Soilscape

9.6.48 Soilscapes (Ref 9-48) information indicates that the Order Limits are underlain by three soil types.

a. The western extents near the existing Black Cat roundabout are underlain by '*Freely draining, slightly acid, loamy soils'* with moderate to low fertility.

b. The area associated with the River Great Ouse is underlain by '*Loamy and clayey floodplain soils with naturally high groundwater*' of moderate fertility.

c. The area extending from the east of the River Great Ouse toward the Caxton Gibbet junction is underlain by '*Lime-rich loamy and clayey soils with impeded drainage*'.

Soil chemistry

9.6.49 Chemical analysis was undertaken on soil samples collected during the *GI* (Ref 9-31), the results of which recorded the following:

a. Soils are alkaline with values of pH ranging from 7.7 to 9.9.

b. Concentration range for heavy metals (Arsenic, Cadmium, Chromium, Lead, Nickel) analysed were all within acceptable limits

c. Petroleum hydrocarbon chemical compounds such as benzene, toluene, ethylbenzene and xylene (BTEX) were not reported in any samples.

9.6.50 Total aliphatic and aromatic hydrocarbons were typically below 35 mg/kg which is within the acceptable limit, with the exception of two samples (BH207 and BH211) located within the existing Black Cat roundabout which recorded total aliphatic concentrations of 280mg/kg and 560 mg/kg respectively, whilst total aromatic hydrocarbons ranged from 620mg/kg to 1400 mg/kg.

Groundwater

9.6.51 The following sections summarise the existing groundwater conditions within the Extended Study Area, including the results of groundwater sampling and monitoring undertaken at locations within the Order Limits as part of the *GI* (Ref 9-31).

9.6.52 Further details regarding the groundwater conditions beneath the Order Limits are provided in **Appendix 13.7 of Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.3]**.

Groundwater source protection zones

9.6.53 There are no groundwater source protection zones (SPZ) within the Extended Geology Study Area.

Groundwater vulnerability zones

9.6.54 The groundwater vulnerability zones within the Extended Geology Study Area are mainly minor (Secondary A) superficial aquifers, with medium to low vulnerability and unproductive minor (Secondary undifferentiated) superficial aquifers with low vulnerability.

9.6.55 Superficial deposits comprising Alluvium, River Terrace and Glaciofluvial deposits are classified by the Environment Agency as Secondary A aquifers.

9.6.56 The Oadby Formation is classified as a Secondary (Undifferentiated) aquifer.

9.6.57 The underlying clay-rich bedrock (the Peterborough Member and the West Walton, Ampthill Clay and Kimmeridge Clay Formations) are classified as Unproductive Strata.

Groundwater occurrence and levels

9.6.58 Monitoring of groundwater elevation undertaken as part of the *GI* (Ref 9-31) identified that within the superficial deposits, groundwater is present principally in the River Terrace Deposits with groundwater levels in the western part of the Order Limits ranging from 0.5 metres to 5.5 metres BGL, while in the central part of the Order Limits, limited groundwater is present in the superficial deposits (i.e. Glacial Till) with groundwater levels ranging from 0.5 metres to 9 metres BGL. In the east of the Order Limits, limited groundwater is also present in the superficial deposits (i.e. Glacial Till) with groundwater levels ranging between 0.5 metres and 13 metres BGL.

9.6.59 Although groundwater has been reported in the Glacial Till, it is considered that this clay-rich deposit is of negligible importance for groundwater in terms of supply and/or providing baseflow to surface water resources.

9.6.60 With the exception of the Glacial Till, groundwater in the superficial deposits (i.e. Alluvium, River Terrace and Glaciofluvial) is in hydraulic continuity with the River Great Ouse and its tributaries and provides baseflow to these watercourses. To the west of the River Great Ouse, groundwater flow direction is generally easterly towards the river. Similarly, to the east of the River Great Ouse, groundwater flows westerly, discharging into the river. Locally there are northerly/north-westerly flows towards the River Great Ouse, particularly around Alington Hill due to the undulating nature of Alington Hill in relation to the surrounding lands and the variation in the groundwater hydraulic gradient from between the peak of the Alington Hill towards to the north and south of the hill as observed from the GI monitoring boreholes.

9.6.61 In the bedrock, groundwater occurrence is minimal and is present only in the sandy layers of the Kellaways Formation. Ground investigation monitoring boreholes (BH203, BH207, BH209, BH211 and BH212) that intercepted this formation indicated that the groundwater in the Kellaways Formation is under confined conditions due to the overlying low permeability, Oxford Clay / West Walton Clay Formations. The average depth at which groundwater was struck in the Kellaways Formation was 22.8 metres BGL, rising to an average of 17.9 metres BGL.

9.6.62 Apart from the River Terrace Deposits, groundwater does not form a significant water resource in the Extended Geology Study Area.

Groundwater quality

9.6.63 Baseline groundwater chemistry has been informed by the results of the in-situ groundwater quality testing and laboratory analyses carried out on water samples collected from 21 groundwater sampling points, comprising boreholes and piezometer located at different locations within the Order Limits. The full details of the results are presented in **Appendix 13.7 Groundwater Risk Assessment of Road Drainage and the Water Environment [TR010044/APP/6.3]** (Chapter 13) of the main Environmental Statement (ES).

9.6.64 Overall, no significant groundwater contamination was reported. The only exception to this is the analytical result for groundwater sample taken from one sampling points (**WS275**) near a former fuel station in the Wyboston area, located approximately 1.2km northeast from the centre of the existing Black Cat roundabout, in the western part of the Scheme, which indicated potential hydrocarbon contamination of the groundwater, with 1,2,4-Trichlorobenzene, 1,2,3-Trichlorobenzene, Naphthalene, Fluoranthene, Phenanthrene, Chrysene, Pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, Indeno(1,2,3-cd) pyrene (aq), Aliphatics >C21-C35, Aromatics >EC12-EC16, Aromatics >EC16-EC21, Aromatics >EC21-EC35 all exceeding the UK Drinking Water Standard (UKDWS). The location of this sampling point is down the hydraulic gradient of the Scheme and is separated from the Black Cat roundabout area of the Scheme, where deep excavations (cuttings and borrow pits) are proposed with potential for groundwater dewatering during construction.

Drinking water

9.6.65 No drinking water safeguard zones (groundwater), and no public or unlicensed private drinking water supply boreholes / abstractions are located within the Extended Geology Study Area.

Groundwater abstractions

9.6.66 Data received during engagement with the Environment Agency in June 2020 confirmed the following licensed groundwater abstractions within the Extended Geology Study Area:

a. Licence no. 6/33/20/*G/0031 – comprising two licences used for spray irrigation and general farming and domestic use, located east of the A1 (Chawston Lane), to the north of the existing Black Cat roundabout.

b. Licence no. 6/33/20/*G/0039 – comprising four licences for spray irrigation and general farming and domestic use, located east of the Great North Road, to the north of the existing Black Cat roundabout.

c. Licence no. 6/33/20/*G/0134 – comprising two licences for spray irrigation and general farming and domestic use, located between Roxton Road and The Lane, to the north of the existing Black Cat roundabout.

Surface water

Watercourses

9.6.67 Surface water features within the Extended Geology Study Area (where direct downstream hydrological connectivity exists) have been identified through a review of relevant data and field surveys undertaken as part of the Road Drainage and the Water Environment assessment (reported in **Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.1]**).

9.6.68 These features are presented in **Table 9-8**, the locations of which are illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.

Table 9-8: Watercourses and their designations identified within the Extended Geology Study Area

Watercourse	Watercourse designation	Sensitivity value	WFD reportable reach
River Great Ouse	Main River	High	Ouse (Roxton to Earith) – GB105033047921
River Ivel	Main River	High	Ivel (DS Langford to Roxton) – GB105033038170
River Kym	Main River	High	Kym – GB105033043270
Hen Brook	Main River	High	Abbotsley and Hen Brooks – GB105033043240
Fox Brook	Main River	High	Not designated – Tributary of Hen Brook
West Brook	Main River	High	West Brook – GB105033042730
Begwary Brook	Ordinary Watercourse	Medium	Begwary Brook – GB105033043230
Stone Brook	Ordinary Watercourse	Medium	Stone Brook – GB105033038190
Wintringham Brook	Ordinary Watercourse	Medium	Not designated – Tributary of Fox Brook
Rockham Ditch	Ordinary Watercourse	Medium	Not designated – Tributary of River Great Ouse
Duloe Brook	Ordinary Watercourse	Medium	Duloe Brook – GB105033043260
Bourn Brook	Ordinary Watercourse	Medium	Bourn Brook – GB105033042690
Colmworth Brook	Ordinary Watercourse	Medium	Colmworth Brook – GB105033043220
South Brook	Ordinary Watercourse	Medium	Not designated – Tributary of River Great Ouse
Gallow Brook	Ordinary Watercourse	Medium	Not designated – Tributary of River Great Ouse
Upstream unnamed tributaries of	Ordinary Watercourse	Low	Situated across the various WFD catchments in the Extended Geology Study Area

Watercourse	Watercourse designation	Sensitivity value	WFD reportable reach
above watercourses			
Field drains and ditches	Ordinary Watercourse	Low	Situated across the various WFD catchments in the Extended Geology Study Area
Several small ponds including ponds at Begwary Brook Nature Reserve	N/A	Negligible	Situated across the various WFD catchments in the Extended Geology Study Area

Discharge activity permits (discharge consents)

9.6.69 Information (correct as of June 2020) obtained from engagement with the Environment Agency identified 45 active discharge activity permits (formerly known as discharge consents) within the Extended Geology Study Area, the details of which are presented in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]** and illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.

Pollution incidents

9.6.70 Information (correct as of June 2020) obtained from engagement with the Environment Agency identified that, for the period 2013–2018, there were 12 pollution incidents of Category 3 (i.e. incidents that have a minor or minimal impact on the environment, people or property with only a limited or localised effect on water quality) relating to the water environment, all of which related to discharges to surface waters. As the recorded incidents are minor, they are not expected to have had long term consequences on the receiving watercourses.

9.6.71 Further details of the incidents are presented in **Chapter 13, Road drainage and the water environment** of the Environmental Statement **[TR010044/APP/6.1]**, the locations (labelled as D1 – D45) of which are illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.

Drinking water

9.6.72 The entirety of the Extended Geology Study Area falls within the drinking water safeguard zone (surface water) (SWSGZ1021), which is associated with the River Great Ouse and is designated to be at risk from pesticides.

9.6.73 Information obtained from engagement with the Environment Agency identified that monitoring samples from this waterbody are currently not complying with the *WFD* (Ref 9-1) and *Drinking Water Directive* (Ref 9-2) standards with seasonal peaks of metaldehyde, propyzamide, carbetamide and quinmerac in the raw river water at sites across the Great Ouse Drinking Water Safeguard Zones, in excess of the drinking water standard. In recent years there have been high concentrations of metaldehyde and propyzamide across the River Great Ouse.

Surface water abstractions

9.6.74 Data received during engagement with the Environment Agency in June 2020 confirmed the following licensed surface water abstractions within the Extended Geology Study Area:

a. Licence no. 6/33/20/*S/0013 – comprising four licences for spray irrigation use (source is the River Great Ouse at Eynesbury Weir), located north-east of Wyboston interchange to the north of the existing A428.

b. Licence no. 6/33/20/*S/0052 – comprising one licence for general use relating to industrial, commercial and public services (source is Begwary Brook), located south of The Lane to the north of the existing Black Cat roundabout.

c. Licence no. 6/33/20/*S/0069 – comprising one licence for spray irrigation use (source is a lake adjacent to the River Great Ouse), located west of the Great North Road to the north of the existing Black Cat roundabout.

d. Licence no. 6/33/20/*S/0116 – comprising two licences for evaporative cooling use (source is the River Great Ouse), located at the power station at Barford Road, south of the existing A428.

e. Licence no. 6/33/20/*S/0131/R01 – comprising one licence for spray irrigation use (source is the River Great Ouse), located adjacent to the River Great Ouse to the north-east of the existing Black Cat roundabout.

f. Licence no. AN/033/0020/001 – comprising one licence for hydroelectric power generation (source is Mill House at the River Great Ouse), located north-east of Wyboston interchange to the north of the existing A428.

Contamination

Conceptual site model

9.6.75 The following sections detail the CSM for the Scheme, defining the plausible linkages between contaminant sources, pathways and receptors that are integral to the establishment of baseline conditions.

Potential sources of contamination

9.6.76 Although the majority of the land within the Geology Study Area comprises undeveloped agricultural land, and as such has a low risk of historical land contamination being present, potential remains for undetected or unconfirmed soil contamination to be present – for example associated with historical land uses and the use of fertilisers and agricultural chemicals.

9.6.77 Other potential sources of land contamination present are associated with historical sites (such as railway lines, former quarries, landfill sites, waste management facilities and fuel filling stations) and/or contemporary land use activities (such as working farms, fuel filling stations and light industrial works).

9.6.78 An unauthorised waste (inert waste) disposal site (formerly known as the “Chawston Lorry Park”) located north west of the existing Black Cat roundabout has also been identified as a potential land contamination site present within the Geology Study Area. Consultation with the Bedford District Council indicated that

extraction of ground mineral has taken place at the site and replaced with inert wastes comprising non-combustible, non-hazardous waste such as brick rubbles, concrete rubbles and subsoils.

9.6.79 Available data obtained from relevant sources and the GI have been reviewed to identify current and historical potential contaminative land uses. **Table 9-9** provides a summary of the key areas of potentially contaminated land within the Geology Study Area.

Table 9-9: Potential sources of contamination within the Geology Study Area

Source location	Potential source	Description	Likely contaminative potential
Within the Geology Study Area	Made Ground	Made ground associated with the existing A421/A428 and the A1.	Low to moderate
	Landfills	The Eversden Landfill near Eltisley , which is currently inactive is understood to have accepted 'other wastes' at the time it was active. The south-western corner of the landfill falls within the Order Limits.	Moderate
	Unauthorised waste (inert waste) disposal site	An Unauthorised waste disposal site located north west of the existing Black Cat roundabout where waste comprising non-combustible, non-hazardous waste such as brick rubbles, concrete rubbles and subsoils has been dumped. Other unknown potentially contaminative materials may have been deposited at this site.	Low to moderate
	Waste sites – Use of waste in construction (<50,000 tonnes)	This relates to road development works at the existing Black Cat roundabout area located within the Geology Study Area - the date of the permit (2012 to 2015) indicates materials would likely be 'suitable for use'. GI data from this location identified no contaminant levels above guideline levels.	Low
	Areas of historical quarrying, potential infilled ground and artificial ground	A number of areas have been identified where ground is understood to have been disturbed, primarily for gravel extraction around the existing Black Cat roundabout (i.e. at Breedon Quarry). Potential to have been infilled with materials of unknown origin. Small areas of potentially infilled ground have also been identified, which may represent a source of potential contamination.	Low to moderate
	Filling stations (garages)	There are historical and current filling stations located within the Geology Study Area with the potential to cause contamination as a result of leaks and spillages of contaminants. These include: A	Moderate

Source location	Potential source	Description	Likely contaminative potential
		historical filling station in the Wyboston area, an active shell filling station immediately north of the existing Black Cat roundabout; An active Shell filling station immediately southwest of the existing Caxton Gibbet roundabout.	
	Historical tanks	Tanks are identified on historical mapping but have not been recorded as registered petroleum storage facilities. The contents or construction (above ground or underground) are not known. It is considered likely that quantities stored are small in comparison with fuel station sites. These include: Petroleum storage facilities located close to the existing Black Cat junction, and Caxton Gibbet junction.	Low to moderate
	Sewage works	A sewage works has been identified to the north of Black Cat junction. Sewage works have the potential to have caused contamination, although, this is likely to be localised.	Low to moderate
	Surface water	Potentially contaminated surface water courses arising from seasonal elevated peaks of pesticides (metaldehyde, propyzamide, carbetamide and quinmerac) in the river water at sites across the Great Ouse.	Low to moderate
	Groundwater	Potentially undetected contaminated groundwater/ landfill leachate arising from the Eversden landfill site and or as a result of historical use of fertilisers, herbicides and pesticides for agricultural purposes.	Low to moderate
	East Coast Main Line	The East Coast Main Line railway has been present since earliest historical mapping. No stations are close to the location where the Scheme crosses the railway, therefore, trains are unlikely to be idling at this location. Contamination possible from equipment leaks. Soils may have been impacted from fuel used as part of railway construction/maintenance equipment, oils/hydrocarbons, PAHs, heavy metals and asbestos.	Low
	Remainder of contemporary / historical contaminative land uses	The remainder of the potentially contaminative land uses identified includes general commercial/light industrial land uses - considered to have low to moderate contaminative potential.	Low to moderate

Source location	Potential source	Description	Likely contaminative potential
	including the presence of asbestos in agricultural farmlands		
	Discharges and pollution incidents	A number of active discharge consents are present across the Geology Study Area, primarily associated with agricultural practices and discharging directly to surface water. Pollution incidents are also known to have occurred (both to land and surface water).	Low
	Existing Road Network within the Geology Study Area	The existing road network such as the existing A428 and A1 roads as well as other smaller link roads is a potential source of contamination - materials used during construction and spills/ leaks during operation. Historical ground investigation at the existing Black Cat roundabout and Caxton Gibbet identified no contaminant concentrations above guideline levels	Low
	Foot and mouth burial pits from agricultural activities across the Geology Study Area	Given the historical agricultural usage of the land with the majority of the Geology Study Area being undeveloped agricultural land, there is potential for unmapped foot and mouth burial pits to be present in the area. Contaminative potential cannot be determined due to the unknown nature of this potential source of pathogens, inorganic compounds, and land gas.	N/A

Potential receptors

9.6.80 **Table 9-10** presents the potential receptors that could be affected by contamination and ground hazards created or disturbed during construction of the Scheme, the study area in which they are located, and their associated value (sensitivity) rating.

Table 9-10: Description of potential receptors

Receptor	Description	Location	Value (sensitivity)
Human health receptors	Construction workers	Order Limits	Very High
	Residents	Geology Study Area	Very high
	Users of community facilities and open spaces	Geology Study Area	High
	Employees and customers at businesses – commercial or industrial.	Geology Study Area	Medium
Controlled waters (within the Extended Geology Study Area)	Groundwater (Secondary A) aquifers and abstractions	Extended Geology Study Area	Medium
	Groundwater (Secondary Undifferentiated) aquifers and abstractions	Extended Geology Study Area	Low
	Surface waters (watercourses and protected drinking water safeguarding area)	Extended Geology Study Area	High
Agricultural soils (within the Order Limits)	ALC Grades 1 and 2	Order Limits	Very high
	ALC Grade 3a	Order Limits	High
	ALC Grade 3b	Order Limits	Medium
	ALC Grades 4 and 5	Order Limits	Low

9.6.81 **Table 9-11** summarises the potential pathways by which contamination sources may come into contact with the receptors identified in **Table 9-10**.

Table 9-11: Potential contamination pathways

Potential pathways		Description
Soil pathways for the following sources: Made ground. Soil leachate.	Dermal contact	Direct contact with contaminated ground soils, soil derived dust, soil leachate and perched water in the made ground.
	Ingestion	Direct or indirect ingestion of made ground soil and soil derived dust.
	Inhalation	Inhalation of made ground soil derived dust, organic vapours or ground generated gas.
Groundwater pathways for the following sources: Soil leachate. Groundwater.	Infiltration and vertical migration via permeable strata	Rainfall infiltration can generate and mobilise contaminants in made ground exposed during construction, resulting in soil-derived leachate impacting on surface waters and groundwater. The majority of the Scheme would include areas of hard standing which would limit the amount of infiltration.
	Lateral migration through aquifers.	Aquifers allow transportation of contaminants through the permeable strata.
Surface water pathways for the following sources: Contaminated surface water runoff . Accidental spillage.	Through stormwater drainage and or surface water flow	Direct discharge of silty water from excavation activities and or hydrocarbon fuel/oil or chemical contaminated stormwater runoff or water used for dust suppression into nearby surface watercourses during construction. Accidental spillage of hydrocarbon fuel/oil and or chemical into surface water courses during construction above water courses.
Gas pathway including the following sources: Ground gas.	Vertical / lateral migration via permeable strata.	Permeable strata and service trenches could potentially allow movement and accumulation of ground gases.

9.6.82 The potential contaminant linkages and associated risks identified for the Scheme are summarised in **Table 9-12**.

Table 9-12: Potential contaminant linkages

Potential Sources	Pathways	Receptor
Made ground and soil leachate	Inhalation or ingestion of soil derived dust. Inhalation of organic vapours. Direct contact with soils or dusts. Leaching into groundwater and migration to surface water bodies.	Human health receptors. Controlled waters Agricultural soils.
Contaminated groundwater	Infiltration and vertical migration via permeable strata. Lateral migration of contaminants through aquifers. Plant uptake of leached substances.	Human health receptors. Controlled waters.
Contaminated surface water / stormwater runoff	Stormwater drainage and or surface water courses	Human health receptors. Controlled waters.
Agricultural use	Inhalation/ingestion/dermal contact. Leaching of contaminants to groundwater in underlying aquifers.	Human health (future site users) Surface water Groundwater
Ground gases	Migration and diffusion via permeable strata.	Human health receptors.

Future baseline conditions

9.6.83 As detailed in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**, a review has been undertaken to determine whether the existing baseline conditions might change between the time of undertaking the assessment and the future years in which the Scheme is planned to be constructed and become operational, as a result of future planned development.

9.6.84 Consideration was given to whether such proposed developments may alter the existing geological and soils resources, for example through the remediation of contaminated land (where development on such land is planned) or from the potential release of contamination.

9.6.85 The review evaluated the planned development projects summarised in **Chapter 15, Assessment of cumulative effects** of the Environmental Statement **[TR010044/APP/6.1]** and involved:

a. The identification of any permitted (i.e. consented) projects within the Order Limits, the Geology Study Area and the Extended Geology Study Area that have yet to be implemented.

b. Analysis of the likely environmental effects and planned timescales for each identified project.

c. An assessment of the potential for each identified project to change the existing baseline conditions in the Construction Year (2022) and Opening Year (2026), in the manner described above.

9.6.86 Although a small number of the development projects are expected to form part of, and influence, the future baseline conditions within the study areas, the review concluded that it is unlikely that these developments would lead to material changes to existing land quality or ground conditions through contamination in year 2022 or year 2026 as:

a. The potential risk of contamination releases and migration to receptors is influenced by whether the land on which they will be developed is already classified as contaminated land under the *EPA* (Ref 9-3).

b. Land identified for development which has potentially contaminative current or historical land uses would need to be remediated prior to those projects being constructed, meaning any contamination would no longer be of significance.

c. Mitigation measures would be employed during construction of these projects to avoid and minimise the risk of contamination migration.

9.6.87 The review also concluded that no major changes to agricultural land are expected to result from either these development projects or large-scale changes in existing farming operations and practices within the Order Limits.

9.6.88 Accordingly, the assessment does not consider future baseline conditions further.

9.7 Potential impacts

9.7.1 The scoping exercise identified that the introduction and / or modification of road infrastructure associated with the Scheme would potentially result in different types and durations of impact on water (i.e. surface water and groundwater), geology (i.e. superficial geology, bedrock geology, geological designated and non-designated sites), soils resources and land contamination, during the construction phase only.

Construction phase

9.7.2 During construction, in the event of disturbance of contaminated soils / groundwater as a result of excavation activities, there is the possibility of impacts on human health and ecological or controlled waters receptors, and for the ground conditions to impact on the design of the Scheme.

9.7.3 The majority of excavated material is expected to comprise natural undisturbed Glacial Till (Oadby Member) with no contamination. As such, the primary risks relate to:

a. the temporary and permanent loss of ALC Grade 1 – 3 (BMV) agricultural lands to the Scheme.

b. excavations for cuttings and borrow pits through geological strata/soils in areas of known historical landfills, agricultural land where fertilisers have been widely used, fuel stations and associated historical fuel storage facilities.

9.7.4 In line with the above, the potential impacts during construction include, but are not limited to, the following:

a. Mobilising existing contaminants in soil and groundwater as a result of exposure following ground disturbance and de-watering during construction.

b. Increasing in the potential for contaminants in unsaturated soils to leach to groundwater in open excavations during construction.

c. Increasing the potential for contaminated surface runoff to migrate to surface water and groundwater receptors as a result of contaminant mobilisation from uncovered stockpiles.

d. Introducing new sources of contamination, such as fuels and oils used in construction plant and fluids and chemicals used in construction methods.

e. Creating preferential pathways for the movement of groundwater through potentially contaminated soil and for ground gases migration, for example, along new below ground service routes and service ducts as a result of construction and associated dewatering activities.

f. Introducing new human health receptors such as site staff/construction workers during construction.

g. Temporary physical damage to, and or permanent loss, of BMV soils (ALC Grade 1 – 3 soils) through temporary and permanent landtake.

h. Physical damage to soil, including: the excavation and temporary storage process for the proposed cuttings; soil compaction as a result of heavy construction vehicle movements; and the exacerbation of soil erosion through handling and storage of soils.

9.8 Design, mitigation, and enhancement measures

Embedded mitigation

9.8.2 Through the design-development process, the Scheme has been designed, as far as possible to avoid and minimise effects on geology and soils through the process of design development, options identification, appraisal, selection and refinement, as described in **Chapter 3, Assessment of alternatives** of the Environmental Statement **[TR010044/APP/6.1]**.

9.8.3 The following measures have been incorporated into the Scheme:

a. The horizontal alignment of the new dual carriageway has been designed to minimise the potential for interaction with known contaminated land, to reduce the likelihood of disturbance.

b. The extent of land required to construct, operate and maintain the Scheme has been designed to minimise the loss of BMV soils.

c. The susceptibility of cut / embankment slopes to erosion has been reduced by incorporating appropriate drainage and by grading slopes to a maximum of 1V:3H gradient (i.e. a slope of 1 metre high vertically for every 3 metres horizontally).

d. The design of pile foundations and other structures requiring deep excavation such as cuttings and borrow pits to avoid the interception of potentially pressurised groundwater in the Kellaways Formation beneath the Oxford Clay.

Essential mitigation

9.8.4 Best practice mitigation measures have been identified which would be implemented by the Principal Contractor to reduce the impacts and effects that construction of the Scheme is likely to have on geological and soil receptors.

9.8.5 These measures are presented within the First Iteration Environmental Management Plan (EMP) **[TR010044/APP/6.8]** and associated appendices: **Appendix E** - Soil Management Plan; **Appendix F** - Water Management Plan; and **Appendix I** - Contaminated Land Management Plan.

9.8.6 These measures broadly focus on but are not limited to:

a. The management of construction activities with the potential for generating contamination through runoff / accidental spillage or by disturbance of in-situ materials.

b. The management of excavated materials as a result of construction works.

c. The management of human receptors associated with the construction workforce.

d. The management of potential impacts on controlled waters.

e. The provision of adequate fuel/chemical storage facilities, such as bunded tanks, hardstanding and associated emergency response/spillage control procedures.

f. The refuelling of vehicles in sealed areas, appropriate storage and use of chemicals and temporary storage of suspected/potentially contaminative materials in local storage bund.

g. The procedures and management of unexpectedly identified contaminated ground during construction.

h. The analytical testing of soil quality against BS 3882:2015 prior to stripping excavations and the management of stripped topsoil and sub-soil material during construction including the storage of such material in local storage bunds.

i. The restriction of soil stripping only to areas that are to be disturbed by construction activities, such as where the soils would be likely to suffer damage associated with engineering activities and or the installation of temporary buildings, haul routes or other areas of hardstanding.

j. The reduction in the over compaction or damage to existing topsoil by ensuring any dedicated haul routes are stripped first with all haul distances minimised.

k. The implementation of adequate measures to ensure the reuse and restoration of temporarily disturbed soils in a healthy condition suitable for revegetation.

l. The location of stockpiles of soils (i.e. both contaminated and uncontaminated soils) as far as possible away from watercourses or other water features to avoid and or reduce the potential risk of pollution from suspended solids, including the use of heavy-duty plastic sheeting to minimise any potential leaching of nutrients and contamination from underlying ground and construction materials.

m. The covering and protection of soil stockpiles with materials adequate to prevent erosion and disbursement by wind or rainwater runoff.

n. The application of an appropriate mitigation (remediation) strategy in the event that contaminated land, including groundwater, is found during construction in order to reduce the potential of any short and long-term health and safety and environmental risks to sensitive receptors.

o. The management of surface water ingress into excavations in accordance with the approaches and techniques presented within the Surface Water Management Plan.

p. The testing of materials to be used in earthworks, including the comparison of chemical test results against Scheme-specific soil re-use acceptability criteria.

q. The implementation and use of protective measures to prevent pathways between contaminants and groundwater and surface water bodies.

r. The implementation of good construction working practices and the correct re-use or disposal of contaminated arisings to minimise the creation of pollution pathways.

s. The temporary on-site storage of contaminated material in designated areas, with materials placed on impermeable sheeting and covered to minimise the potential for leachate and runoff from stockpiles being generated.

t. The sheeting of lorries when transporting ground materials off-site and the use of dust suppression equipment on site, to reduce potential migration of dust that might contain potentially contaminated materials.

u. The management of the risk of pollution to surface water and groundwater.

v. The management of activities within floodplains in the area of River Great Ouse, Stone Brook, Hen Brook, and South Brook (i.e. kept to a minimum) with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable or allowances made for floodplain control measures and contingency actions.

w. The management of water removed from excavations such as cuttings and borrow pits for construction dewatering activities.

x. The management of the risk of groundwater flooding through appropriate working practices (during excavations) and with adequate plans and equipment in place for de-watering to ensure safe, dry working environments.

y. The monitoring of both groundwater and surface water quality in advance of any construction works to augment any existing data and to establish robust baseline conditions against which any changes in water quality during construction works can be compared.

z. The restriction and control of runoff from all construction sites to be discharged directly to any watercourse only under permit from the EA and following treatment and attenuation using a variety of measures alone or in combination including sediment barriers such as silt fences, straw bales and earth bunds (used and positioned in appropriate locations).

9.8.7 Based on the effectiveness of best practice mitigation, no additional or offsetting mitigation measures would be required during construction of the Scheme.

Enhancement measures

9.8.8 No enhancement measures relating to geology and soils have been incorporated into the design of the Scheme.

9.9 Assessment of significant effects

9.9.1 In accordance with *LA 104* (Ref 9-22), the prediction of impacts and the assessment of effects (and their significance) on geology and soils associated with construction of the Scheme has taken account of the effectiveness of both the embedded and essential mitigation measures summarised in Section 9.8.

Construction effects

Contamination

Human health receptors

9.9.2 Human health receptors likely to be affected by the Scheme during the construction phase include residents living close to the Scheme in residential areas, construction workers, people using open public spaces or allotments, and those using commercial / industrial properties within the vicinity of the Scheme.

9.9.3 If contaminated soil or groundwater is encountered in the course of excavation and construction works, there are potential impacts on human receptors. Potential impacts may occur from the release of contaminated dust to the air causing a nuisance / health effect to human receptors. Exposure to contaminants could occur through various pathways including; dermal contact, ingestion, inhalation and migration through groundwater.

9.9.4 The sensitivity of these human receptors ranges from medium to very high. The highest rating concerns residents living near the Scheme and construction workers who would experience prolonged exposure. However, the magnitude of the impact would be dependent on the nature of the contamination, relative exposure duration, together with the proximity of each receptor to the construction works.

9.9.5 No land and/or groundwater contamination has been identified during the *Ground Investigation* (Ref 9-31). In the absence of any plausible sources of contamination, potential risks to human health will be low. The magnitude of impact on human health resulting from exposure to soil dust and uncontrolled contaminated runoff or groundwater is defined as negligible. Accordingly, with essential mitigation measures adopted and implemented as outlined in the First Iteration EMP **[TR010044/APP/6.8]**, the significance of effect from the uncontrolled release of potentially contaminated soil-derived dust, including asbestos, contaminated surface water runoff or groundwater on human health receptors is considered to be no worse than slight adverse, which is not significant.

9.9.6 The risks from the accumulation of ground gases during the construction phase are likely to impact on human receptors such as construction workers, particularly in areas close to historical landfill sites such as the Eversden Landfill located within the Geology Study Area. It is a requirement for the Principal Contractor to undertake an adequate risk assessment before commencement of any construction activities to restrict and manage any potential exposure to harmful substances or ground gases. The potential impacts specific to construction workers are expected to be mitigated through the implementation of appropriately specified site controls and procedures including the use of Personal Protective Equipment.

9.9.7 During the construction phase, access to confined spaces and excavations would be restricted. Where work in confined spaces is unavoidable, site-specific and task-specific risk assessments would be undertaken before the commencement of the works. Such work would also include measures as detailed in the EMP to minimise the effects of the work on human health. Monitoring of confined spaces for ground gas accumulation would be carried out, with the works undertaken by suitably trained personnel with the use of specialist personal protective equipment. Taking into consideration these measures, the magnitude of impact on human receptors from ground gas migration during construction would be negligible. Accordingly, the significance of effects on human receptors would be no worse than slight adverse, which is not significant.

Controlled waters (Groundwater)

9.9.8 For land contamination, construction works such as deep excavation and associated dewatering activities have the potential to cause adverse effects through the mobilisation of existing contamination in soils and groundwater to migrate to non-contaminated soils and groundwater.

9.9.9 A qualitative and quantitative assessment of impacts from or to, soil and groundwater has been undertaken for the construction phase of the Scheme (see **Appendix 13.7 of Chapter 13, Road drainage and the water environment [TR010044/APP/6.3]**) Construction activities such as piling and excavation for foundations associated with any bridge construction could provide a preferential pathway for contaminants to migrate to non-contaminated soils and subsequently into groundwater throughout the construction period. However, any contaminated soils exposed during construction would be expected to be removed, treated and / or mitigated as part of the construction process and before the foundations are constructed.

9.9.10 Dewatering of deep excavations such as cuttings and borrow pits would be required, which would generate groundwater that would need to be managed and discharged appropriately from the site. The draft DCO seeks, subject to consent from the Environment Agency, to disapply section 24 of the Water Resources Act 1991 which would remove the need to obtain an abstraction licence for this activity. However, in the event that such consent is not granted, an abstraction licence will be required when abstracting more than 20 m^3/day, which would be obtained from the Environment Agency. Where discharges from the site are uncontrolled, this could result in pollution of receiving waters which may impact on surface water quality. If too much water is discharged, or the discharge rate is too high in the absence of sufficient controls, the capacity of the receiving surface water environment could be exceeded which may cause flooding off-site on the broader area. The essential mitigation measures required to address these are summarised in **Chapter 13, Road drainage and the water environment [TR010044/APP/6.1]** and are detailed more fully in (and would be secured through) the First Iteration EMP **[TR010044/APP/6.8]**.

9.9.11 During construction, it would be necessary to dewater groundwater, particularly in areas where groundwater would be encountered as a result of deep excavation such as cuttings and borrow pits required to facilitate the construction of the Scheme. Assessments of the impact of the required dewatering on groundwater levels, flows and quality at specific locations of potential deep excavation are provided in **Appendix 13.7** of **Chapter 13, Road drainage and the water environment [TR010044/APP/6.3]** in the Environmental Statement **[TR010044/APP/6.3]**. In summary the significance of the effects on groundwater level, flow, quality and groundwater receptors, such as licensed groundwater sources, as a result of dewatering at these locations are considered to be no worse than slight adverse, which is not significant.

9.9.12 Based on the assessment, and given that no evidence of potential contamination was detected during the GI (Ref 9-31) it is concluded that the water abstracted during construction dewatering would be uncontaminated and that the ground conditions would have no adverse impact on the chemical quality of the water discharged to the surface watercourses from these areas. However, further verification through groundwater quality and level monitoring would be put in place at these locations during construction of the Scheme, the details of which are presented in the First Iteration EMP **[TR010044/APP/6.8]**.

9.9.13 Groundwater in the Geology Study Area is present mainly in the superficial deposits of Alluvium and the River Terrace Deposits, which are present only in the floodplains of the River Great Ouse and its tributaries in the west of the Geology Study Area. Groundwater is also present thin granular units within the Glacial Till, but only in limited quantity due to the low permeability nature of the formation.

9.9.14 Within the bedrock, groundwater is also present at depth under sub-artesian pressure in granular / permeable layers within the Kellaways Formation.

9.9.15 The Environment Agency has designated the Alluvium and River Terrace Deposits as a Secondary A aquifer that is only able to sustain local abstraction. Accordingly, in line with DMRB LA113 criteria (Ref 9-23), a medium sensitivity value has been assigned to the Alluvium and the River Terrace Deposits. Glacial Till covers a large part of the eastern part of the Scheme and the Geology Study Area and has been designated as a Secondary Undifferentiated aquifer with limited groundwater potential by the Environment Agency. Based on these designations and in line with DMRB criteria, a low sensitivity value has been assigned to Glacial Till. Therefore, the magnitude of impact on groundwater quality in the superficial aquifers resulting from construction activities is considered to be minor as any potential impacts would be localised with minimal dispersion. Accordingly, the significance of effects on groundwater quality in the superficial aquifers would be no worse than slight adverse, which is not significant.

9.9.16 The Oxford Clay and West Walton Formations, which are primarily the bedrock geology beneath the Geology Study Area, have been designated as unproductive aquifers with negligible importance for groundwater resource by the Environment Agency. Based on this, and in line with the DMRB LA 113 criteria (Ref 9-25) a low sensitivity value has been assigned for the bedrock aquifer (i.e. unproductive aquifer with negligible significance for water supply or river base flow). As such the magnitude of impact on groundwater quality in the bedrock aquifer resulting from construction activities would be negligible. Accordingly, the significance of effects would be neutral, which is not significant.

Controlled waters (surface water)

9.9.17 The prevention of surface water pollution during the construction phase would be achieved via the essential mitigation measures as outlined in the First Iteration EMP **[TR010044/APP/6.8]**. The measures aim to manage surface water runoff from the construction site (site preparation, earthworks and construction

activities) to reduce as far as practicable the potential for adverse impacts to receiving watercourses.

9.9.18 Dewatering of borrow pits and cuttings has the potential to mobilise suspended solids and soluble contaminants which would be discharged to the surface water systems such as the River Great Ouse and its tributaries. The sensitivity of these receptors ranges from medium to very high, the highest rating concerns the River Great Ouse.

9.9.19 Given that no potentially contaminated land is identified within the Order Limits and in areas where discharges to the surface water system arising from dewatering activities are likely to occur, the magnitude of any potential impacts on water quality is considered to be negligible. Accordingly, the significance of effect has been assessed to be no worse than slight adverse, which is not significant.

9.9.20 During construction, surface water quality impacts can also arise from the uncontrolled discharge of hydrocarbons and or chemically contaminated runoff into nearby watercourses as a result of accidental spillages or silty water from the operation of construction and general earthworks activities. For example, there is a plausible risk of earthworks activities during periods of normal or severe rainfall to give rise to an increased concentration of suspended solids in runoff water. Consequently, in the absence of mitigation measures, surface water runoff containing high suspended solids could accidentally enter nearby watercourses which may have potentially damaging effects such as increased turbidity and blanketing of the stream bed. Also, depending on the volume, hydrocarbons (i.e. leakage from plant and equipment at worksite areas) and or chemically contaminated surface runoff can temporarily impact on the water quality of the receptor.

9.9.21 The impact on surface water receptors, including the River Great Ouse and its tributaries and ecological dependent species; on groundwater and groundwater dependent terrestrial ecosystems are included in **Chapter 13, Road drainage and the water environment [TR010044/APP/6.1].** The EMP includes measures to prevent uncontrolled discharges of potentially contaminated surface water runoff from excavation and construction activities into nearby watercourses. Other essential mitigation measures are discussed in **Chapter 13, Road drainage and the water environment [TR010044/APP/6.1]**.

Soil resources

9.9.22 The total area of land within the Order Limits is approximately 713 hectares (ha).

9.9.23 Construction of the Scheme would necessitate an unavoidable loss and disturbance of soil resources, a high percentage of which comprise BMV soils.

9.9.24 Based on the extents of the temporary and permanent landtake defined on the Land Plans **[TR010044/APP/2.2]**, the following disturbance and losses are predicted to result from construction:

a. Approximately 52.77ha of temporary disturbance and 37.17ha of permanent loss of ALC Grade 1 soils.

b. Approximately 411.75ha temporary disturbance and 285.40ha of permanent loss of ALC Grade 2 soils.

c. Approximately 47.36ha temporary disturbance and 26.37ha of permanent loss of ALC Grade 3 soils.

d. Approximately 0.46ha temporary disturbance and no permanent loss of ALC Grade 4 soils.

9.9.25 Based on the worst-case assumption that all ALC Grade 3 soils within the Order Limits are BMV, there would be a total permanent loss of 348.94ha of BMV soils (ALC Grade 1, 2 and 3) and a total temporary disturbance of 511.881ha of BMV soils.

9.9.26 Agricultural lands classed as BMV are considered to be soils receptors of very high sensitivity. **Table 9-1** indicates that the magnitude of impact for the loss of >20ha of BMV agricultural land would be major. Accordingly, the significance of the effect of the Scheme on Grades 1 and 2 agricultural land has been assessed as very large adverse (significant).

9.9.27 As discussed in **Table 9-1**, and for the purpose of the impact assessment, the sensitivity of both the ALC Grades 3a and 3b agricultural land are classed as high. **Table 9-1** also indicates that the magnitude of impact for the loss of 1ha to 20ha of BMV agricultural land would be moderate. Accordingly, the significance of effect of the Scheme on Grade 3 agricultural land has been assessed as large adverse (significant).

9.9.28 Measures contained within the First Iteration EMP **[TR010044/APP/6.8]** would be implemented during construction of the Scheme to mitigate impacts associated with the construction of the Scheme that would result in the loss of BMV soils. Further measures would be taken to avoid and / or minimise adverse impacts to BMV soils based upon the Defra Construction Code of Practice for the Sustainable Use of Soil on Development Sites (Ref 9-58). **Table 9-13** provides a summary of the significance of effects on ALC grade within the Order Limits.

Table 9-13: Permanent loss of agricultural land classification grades within the Order Limits

	ALC Grade 1	ALC Grade 2	ALC Grade 3	ALC Grade 4	Non-Agricultural
Description	Excellent	Very Good	Good to Moderate	Poor	Other land primarily in non-agricultural use
Total available within Order Limits (ha)	52.77	411.75	47.36	0.46	1.27

	ALC Grade 1	ALC Grade 2	ALC Grade 3	ALC Grade 4	Non-Agricultural
Temporary Loss to the Scheme (ha)	52.77	411.75	47.36	0.46	1.27
Permanent Loss to the Scheme (ha)	37.17	285.40	26.37	0.0	1.02
Percentage (%) of ALC in the Order Limits	10.3	80.2	9.2	0.1	0.2
Sensitivity	Very High	Very High	High	Low	Negligible
Magnitude of Impact based on DMRB Criteria	Major	Major	Moderate	Negligible	No change
Effect Significance	Very large adverse - significant	Very large adverse - significant	Large adverse - significant	Neutral adverse	Neutral

Geology

9.9.29 No designated important geological exposures have been identified within the Geology Study Area. The sensitivity of geology across the Scheme is very low and is not of local interest. The magnitude of impact would be negligible as the overall integrity of the resource would not be affected.

9.9.30 The Scheme would have a neutral effect on geology during construction, which is not significant.

Summary of significant effects

Table 9-14: Summary of significant construction effects on geology and soils

Description of resource / receptor and impact	Value of receptor	Magnitude of impact	Significance of effect
Soil Resource			
Permanent loss of 37.17ha of soil resources BMV agricultural land Grade 1	Very high	Major	Very large adverse - significant
Permanent loss of 285.40ha of soil resources BMV agricultural land Grade 2	Very high	Major	Very large adverse - significant

Permanent loss of 26.37ha of soil resources BMV agricultural land Grade 3	High	Moderate	Large adverse - significant

9.10 Monitoring

Construction effects

9.10.2 The assessment has concluded that, with the exception of the significant (large to very large adverse) effect associated with the permanent loss of ALC Grade 1-3 agricultural land, significant adverse effects on Geology and Soils would not result from the construction of the Scheme.

9.10.3 To reduce the significant adverse effect to as far as practicable, where temporary loss of (or change to) agricultural land has occurred during construction, monitoring would be undertaken during the construction phase to ensure that affected land is restored to acceptable agricultural use.

9.10.4 Post-construction monitoring would be undertaken to determine whether pre-existing agricultural soil capability has been reinstated following completion of the works.

9.10.5 The requirements for soil handling, reinstatement, aftercare and monitoring are detailed in the framework Soil Management Plan within the First Iteration EMP **[TR010044/APP/6.8]**.

9.11 References

Ref 9-1 Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy. European Parliament and the Council of the European Union (2000). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060

Ref 9-2 Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. The Council of the European Union (1998). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31998L0083

Ref 9-3 Environmental Protection Act 1990. HMSO (1990). http://www.legislation.gov.uk/ukpga/1990/43/contents

Ref 9-4 Environment Act 1995. HMSO (1995). https://www.legislation.gov.uk/ukpga/1995/25/contents

Ref 9-5 Water Act 2003. HMSO (2003). https://www.legislation.gov.uk/ukpga/2003/37/contents

Ref 9-6 The Contaminated Land (England) Regulations 2006. HMSO (2006). https://www.legislation.gov.uk/uksi/2006/1380/contents/made

Ref 9-7 Water Resources Act 1991. HMSO (1991). https://www.legislation.gov.uk/ukpga/1991/57/contents

Ref 9-8 National Policy Statement for National Networks. Department for Transport (2014) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

Ref 9-9 Overarching National Policy Statement for Energy (EN-1). Department of Energy & Climate Change (2011). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

Ref 9-10 National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4). Department of Energy & Climate Change (2011). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47857/1941-nps-gas-supply-oil-en4.pdf

Ref 9-11 National Planning Policy Framework. Ministry of Housing, Communities & Local Government (2019). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

Ref 9-12 Planning Practice Guidance: Land stability. Ministry of Housing, Communities & Local Government (2019). https://www.gov.uk/guidance/land-stability

Ref 9-13 Planning Practice Guidance: Land affected by contamination. Ministry of Housing, Communities & Local Government (2019). https://www.gov.uk/guidance/land-affected-by-contamination

Ref 9-14 Huntingdonshire's Local Plan to 2036. Huntingdonshire District Council (2019). https://www.huntingdonshire.gov.uk/media/3872/190516-final-adopted-local-plan-to-2036.pdf

Ref 9-15 South Cambridgeshire Local Plan 2018. South Cambridgeshire District Council (2018). https://www.scambs.gov.uk/planning/local-plan-and-neighbourhood-planning/the-adopted-development-plan/south-cambridgeshire-local-plan-2018/

Ref 9-16 Bedford Borough Local Plan 2030. Bedford Borough Council (2020). https://bbcdevwebfiles.blob.core.windows.net/webfiles/Planning%20and%20Building/local-plan-2030/Local%20Plan%202030%20ADOPTED%20VERSION.pdf

Ref 9-17 The Central Bedfordshire Pre-submission Local Plan 2015 – 2035. Bedford Borough Council (2018). https://www.centralbedfordshire.gov.uk/migrated_images/pre-submission-local-plan-compressed-v2_tcm3-27081.pdf

Ref 9-18 Design Manual for Roads and Bridges: Volume 11. Highways England (1993 – 2019) [WITHDRAWN].

Ref 9-19 Interim Advice Note 125/15: Environmental Assessment Update (2015) [WITHDRAWN].

Ref 9-20 A428 Black Cat to Caxton Gibbet: Environmental Scoping Report. Highways England (2019). https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010044/TR010044-000006-BCCG%20-%20Scoping%20Report.pdf

Ref 9-21 Design Manual for Roads and Bridges. Highways England (2019 – 2020). http://www.standardsforhighways.co.uk/dmrb

Ref 9-22 Design Manual for Roads and Bridges: LA 104 Environmental assessment and monitoring (Revision 1). Highways England (2020). https://www.standardsforhighways.co.uk/prod/attachments/0f6e0b6a-d08e-4673-8691-cab564d4a60a

Ref 9-23 Design Manual for Roads and Bridges: LA 109 Geology and soils (Revision 0). Highways England (2019). https://www.standardsforhighways.co.uk/prod/attachments/adca4c7d-4037-4907-b633-76eaed30b9c0

Ref 9-24 Design Manual for Roads and Bridges: LA 110 Material assets and waste (Revision 0). Highways England (2019). https://www.standardsforhighways.co.uk/prod/attachments/6a19a7d4-2596-490d-b17b-4c9e570339e9

Ref 9-25 Design Manual for Roads and Bridges: LA 113 Road drainage and the water environment (Revision 1). Highways England (2020). https://www.standardsforhighways.co.uk/prod/attachments/d6388f5f-2694-4986-ac46-b17b62c21727

Ref 9-26 BS 10175: 2011+A2:2017: Investigation of Potentially Contaminated Sites. Code of Practice. British Standards Institution (2011). https://shop.bsigroup.com/ProductDetail?pid=000000000030362551

Ref 9-27 Land contamination: risk management. Environment Agency (2020). https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

Ref 9-28 The Definition of Waste: Development Industry Code of Practice (Version 2). CL:AIRE (2011). https://www.claire.co.uk/component/phocadownload/category/8-initiatives?download=212:definition-of-waste-development-industry-code-of-practice

Ref 9-29 Guide to assessing development proposals on agricultural land. Natural England (2018). https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development/guide-to-assessing-development-proposals-on-agricultural-land

Ref 9-30 Code of practice for the sustainable use of soils on construction sites. Department for Environment, Food & Rural Affairs (2009). https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites

Ref 9-31 A428 Black Cat to Caxton Gibbet Improvements Ground Investigation Report - HE551495-ACM-VGT-GEN_SW_Z_ZZ-RP-GE-0004 P02 S3 HAGDMS no. 31712. AECOM (2020).

Ref 9-32 Envirocheck Professional GIS data and historical Ordnance Survey mapping in GIS format obtained for this PSSR (500m buffer around Option 1, Option 5 and Option 6). Landmark Ltd (2017).

Ref 9-33 Envirocheck Professional GIS data and historical Ordnance Survey mapping in GIS format obtained for this PSSR (500m buffer around). Landmark Ltd (2019).

Ref 9-34 A428 Black Cat to Caxton Gibbet Upgrade - Preliminary Sources Study Report - HE55149-JAC-HGT-00-REP-GE-0001/1.0 - HAGDMS report 29471. Jacobs (2017).

Ref 9-35 A428 Black Cat to Caxton Gibbet Improvements Preliminary Sources Study Report (PSSR) (HE551495-ACM-VGT-A428_SW_Z_XX-RP-GE-0002: HAGDMS report 30431). AECOM (2020).

Ref 9-36 1:50,000 Scale Mapping – Sheet 187 (Huntingdon). British Geological Survey. https://webapps.bgs.ac.uk/data/publications/pubs.cfc?method=viewHome

Ref 9-37 1:50,000 Scale Mapping – Sheet 204 (Biggleswade). British Geological Survey. https://webapps.bgs.ac.uk/data/publications/pubs.cfc?method=viewHome

Ref 9-38 Hydrogeology of the area between Cambridge and Maidenhead including parts of hydrometric areas 33,38 and 39 (1:100,000 scale). British Geological Survey (1984).

Ref 9-39 Unexploded Bomb risk map. Zetica (2020). https://zeticauxo.com/downloads-and-resources/risk-maps/

Ref 9-40 Geoindex. British Geological Survey (2020). https://mapapps2.bgs.ac.uk/geoindex/home.html

Ref 9-41 Cambridgeshire Geological Society website. Cambridgeshire Geological Society. http://www.cambsgeology.org/

Ref 9-42 Bedford Geology Group website. Bedford Geology Group (2020). https://www.bedfordshiregeologygroup.org.uk/

Ref 9-43 Environment Agency website. Environment Agency (2020). https://www.gov.uk/government/organisations/environment-agency

Ref 9-44 MAGIC online interactive mapping. Department for Environment Food & Rural Affairs. https://magic.defra.gov.uk/magicmap.aspx

Ref 9-45 The Coal Authority Interactive Viewer. The Coal Authority (2020). https://mapapps2.bgs.ac.uk/coalauthority/home.html

Ref 9-46 Agricultural Land Classification: protecting the best and most versatile agricultural land – Technical Information Note TIN 049. Natural England (2009). http://adlib.everysite.co.uk/resources/000/095/416/TIN049.pdf

Ref 9-47 East Region: 1:250,000 Series Agricultural Land Classification. Natural England (2018). http://publications.naturalengland.org.uk/file/130045

Ref 9-48 Soilscapes soil types viewer. Cranfield University Soil and AgriFood Institute (2020).http://www.landis.org.uk/soilscapes/