

A12 Chelmsford to A120 widening scheme TR010060

6.1 ENVIRONMENTAL STATEMENT CHAPTER 10 GEOLOGY AND SOILS

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ENVIRONMENTAL STATEMENT CHAPTER 10 GEOLOGY AND SOILS

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10 Geology and soils

10.1 Topic introduction

- 10.1.1 This chapter presents the information required by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended) to be provided in the Environmental Statement for the proposed A12 Chelmsford to A120 widening scheme (the proposed scheme) in respect of geology and soils.
- 10.1.2 This chapter provides an assessment of the likely significant effects of the proposed scheme with respect to geology and soils in accordance with the Design Manual for Roads and Bridges (DMRB) LA 109 Geology and Soils (Highways England, 2019). The effects of both construction and operation of the proposed scheme have been assessed. Mineral resources are covered in Chapter 11: Material assets and waste, of the Environmental Statement [TR010060/APP/6.1]. Hydrogeology, where not associated with land contamination, is covered in Chapter 14: Road drainage and the water environment [TR010060/APP/6.1].
- 10.1.3 The matters covered in this chapter include geology (bedrock geology and superficial deposits including geological designations and valuable non-designated features), soil resources (mostly agricultural), and land contamination (effects on human health, surface water and groundwater).
- 10.1.4 This chapter is supported by the following figures [TR010060/APP/6.2]:
- Figure 10.1: Geology and Soils Land Contamination Constraints Plan
 - Figure 10.2: Agricultural Land Classification
- 10.1.5 This chapter is supported by the following appendices [TR010060/APP/6.3]:
- Appendix 10.1: Land Quality Risk Assessment
 - Appendix 10.2: Agricultural Land Classification Survey Report

10.2 Competent expert evidence

- 10.2.1 This assessment has been undertaken and reported by a team of competent land quality specialists. The competent expert responsible for this assessment is an associate director and chartered geologist with The Geological Society. They have over 25 years' experience of undertaking geology and soils assessments for major infrastructure and linear projects, including highways, for which the process of EIA (Environmental Impact Assessment) has been required.

10.3 Stakeholder engagement

- 10.3.1 Table 10.1 provides a summary of the key stakeholder feedback and key requirements from the Planning Inspectorate as identified within the Scoping Opinion (Planning Inspectorate, 2021) relevant to the assessment of geology and soils.

Table 10.1 Key Scoping Opinion feedback for geology and soils

Stakeholder	Comment	Applicant's response
<p>The Planning Inspectorate</p> <p>Email from the Planning Inspectorate received 7 December 2020</p>	<p>The Planning Inspectorate agreed that the Marks Tey Brickpit Site of Special Scientific Interest (SSSI) and associated risk to human health for site users and the general public during operation can be scoped out of the assessment.</p> <p>However, the Planning Inspectorate stated that the Scoping Report did not provide sufficient evidence that the drainage and runoff from the proposed scheme during operation would not result in significant effects to soils, groundwater or surface water in areas adjacent to the scheme. On this basis, the operational impact on soils, groundwater and surface water should not be scoped out.</p>	<p>Marks Tey Brickpit SSSI and the potential risk to human health for site users and the general public during operation have been scoped out of the assessment.</p> <p>Although operational effects on soils, surface water and groundwater have been scoped out of the geology and soils aspect, they are scoped into the road drainage and water environment aspect in terms of potential pollution from road runoff and drainage. Drainage will be designed to prevent significant impacts on soils, refer to Appendix 14.6 of the Environmental Statement [TR010060/APP/6.3].</p>
<p>Environment Agency</p> <p>Date of enquiry: 27 November 2020</p> <p>Response: 22 December 2020</p> <p>Reference EAn/2020/196637</p>	<p>The Environment Agency was consulted on potentially contaminated sites identified on and within 500m of the study area including historical landfills. They confirmed via email that the nature of wastes received by one of the historical landfills at Witham (Blackwater Lane landfill) included hazardous wastes.</p> <p>Other landfill information provided by the Environment Agency generally confirmed the available information obtained during the desk study stage of this assessment, including the historical landfill at junction 25 which has been investigated as part of ground investigation (GI) works.</p> <p>The Environment Agency commented that, due to the age of the deposits within the landfill sites, there will be many uncertainties as to the actual waste inputs.</p> <p>They recommended that any works disturbing the landfill wastes must be fully assessed for impacts that may lead to mobilisation of contaminants and thereby increase the risk of groundwater pollution. They advised</p>	<p>Although the Scoping Opinion stated that the Environment Agency records indicate that the historical Perry Road landfill took hazardous waste, feedback from subsequent consultation with the Environment Agency indicates that the historical Perry Road landfill received industrial, commercial and household wastes. All of these wastes may include hazardous components, and it should be noted that past waste categories do not directly compare to current waste classifications.</p>

Stakeholder	Comment	Applicant's response
	that site investigations should be considered to determine the ground conditions and appropriate protocols, including remedial measures to be put in place should unsuitable or unexpected material be encountered.	
Natural England Date of enquiry: 11 November 2020 Response: 30 November 2020	Natural England confirmed that impacts from the proposed scheme should be considered in light of the Government's policy for the protection of the best and most versatile (BMV) agricultural land as set out in the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2021). They recommended that an Agricultural Land Classification (ALC) survey should be carried out, if not already available, and advised that the Environmental Statement should provide details of how any adverse impacts on soils can be minimised.	An ALC survey has been undertaken to clearly identify areas of BMV land and is included in Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]. Natural England were consulted with regards to the scope of the ALC survey, and the survey density was agreed via correspondence.
Braintree District Council Response: 15 February 2021	Braintree District Council commented that the majority of Braintree District consists of BMV agricultural land. Although the proposed scheme is linear in nature, the cumulative impact of the loss of such land (i.e. parts of many agricultural fields) could be major and the Council requested that the Environmental Statement give due consideration to this and clearly identify the quantity, locations and categories of such land which would be lost.	An ALC survey has been undertaken to clearly identify areas of BMV land and is included in Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]. Natural England were consulted with regards to the scope of the ALC survey, and the survey density was agreed via correspondence.

10.3.2 The full Scoping Opinion, as well as the Applicant's response regarding how and where comments have been addressed in the Environmental Statement and draft Development Consent Order (DCO), is included within Appendix 5.1 of the Environmental Statement [TR010060/APP/6.3].

10.3.3 All comments raised during the statutory consultation, as well as the Applicant's responses, are included in the Consultation Report [TR010060/APP/5.1]. No significant issues were raised in statutory consultation in relation to geology and soils.

10.4 Legislative and policy framework

Legislation

10.4.1 The following statutory provisions (with amendments) are relevant to geology and soils:

- Environmental Protection Act 1990: Part IIA (Contaminated Land)
- Environmental Damage (Prevention and Remediation) (England) Regulations (SI 2015/810)
- Contaminated Land (England) Regulations (SI 2006/1380)
- Water Resources Act 1991
- Water Act 2003
- Waste (England and Wales) Regulations 2011 (SI 2011/988)
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (SI 2017/407)
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- Environmental Permitting (England and Wales) Regulations 2016 (SI 2016/1154)
- Water Supply (Water Quality) Regulations 2016 (SI 2016/614)

10.4.2 These regulations seek to protect human health and the environment from contaminated land and set out responsibilities in relation to soil and water pollution.

10.4.3 As regards water quality, the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (hereafter referred to as the Water Framework Directive (WFD)) have a number of objectives which aim to protect water quality. The key objectives are general protection of aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water. The overall objective is for river basins to achieve 'good status'.

National plans and strategies

10.4.4 The following national objectives are relevant to geology and soils:

- A Green Future: Our 25 Year Plan to Improve the Environment (HM Government, 2018). The key objective detailed in the strategy which has been considered in this assessment is as follows:
 - 'Improving our approach to soil management: by 2030 we want all of England's soils to be managed sustainably, and we will use natural capital thinking to develop appropriate soil metrics and management approaches'.
- Safeguarding our Soils: A Strategy for England (Department for Environment, Food and Rural Affairs (Defra), 2011). The key objective considered in this assessment is as follows:

- 'Vision: By 2030, all England's soils will be managed sustainably and degradation threats tackled successfully. This will improve the quality of England's soils and safeguard their ability to provide essential services for future generations'.
- The Natural Choice: Securing the Value of Nature (HM Government, 2011) emphasises the importance of natural resource protection, including the conservation and sustainable management of soil and the protection of BMV agricultural land.

National policy

National Policy Statements

- 10.4.5 The National Networks National Policy Statement (NNNPS) (Department for Transport, 2014) sets out the Government's policies to deliver the development of Nationally Significant Infrastructure Projects on the national road and rail networks in England. The Secretary of State uses the NNNPS as the primary basis for making decisions on DCO applications.
- 10.4.6 Key policy from the NNNPS relevant to this aspect is set out in Table 10.2.

Table 10.2 NNNPS requirements for geology and soils

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
Paragraph 5.168	Applicants should take into account the economic and other benefits of the BMV agricultural land (defined as land in grades 1, 2 and 3a of the ALC system). Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality. Applicants should also identify any effects, and seek to minimise impacts, on soil quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites provided that it is not of high environmental value.	Sections 10.8 and 10.9 of this chapter detail the site-specific ALC survey undertaken for the proposed scheme. The full report is presented in Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]. The design for all elements of the proposed scheme has sought to limit land take as far as practicable. Permanent sealing or wastage of topsoil would be avoided via stripping and reuse elsewhere, and best practise soil management measures would be followed to limit degradation during its handling. The proposed soil management measures to be adopted during construction are detailed in Section 10.10 of this chapter.
Paragraph 5.176	The decision-maker should take into account the economic and other benefits of the BMV agricultural land. The decision-maker should give little weight to the loss of agricultural land in grades 3b, 4 and 5 (as defined in the ALC system, described in Section 10.9 of this chapter)) except in areas (such as uplands) where particular agricultural practices may themselves contribute to the quality and character of the environment or the local economy.	

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
Paragraph 5.168	For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination and how it is proposed to address this. The policy recommends the adoption of the Model Procedures for Management of Land Contamination (CLR11), which sets out procedures for risk assessment, deciding on remedial options and implementing remediation. The Environment Agency published an online replacement to this document in May 2020 entitled Land Contamination: Risk Management (LCRM) (Environment Agency, 2020).	A land quality risk assessment has been completed in line with LCRM. A summary of the assessment is included in Section 10.8 of this chapter and is included in full in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].
Paragraph 5.22	Where the project is subject to EIA the applicant should ensure that the Environmental Statement clearly sets out any likely significant effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England).	Marks Tey Brickpit geological SSSI has been scoped out of this assessment and therefore opportunities for geological conservation are limited.
Paragraph 5.23	The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.	
Paragraph 5.25	As a general principle, and subject to the specific policies of the NNNPS, development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.	

10.4.7 As set out in Chapter 1: Introduction, of the Environmental Statement [TR010060/APP/6.1], the assessment has considered the Overarching National Policy Statement for Energy (EN-1) and National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011a; 2011b) in relation to the diversion of an existing high-pressure gas main (the 'gas main diversion') owned and operated by Cadent Gas Limited (Cadent). Draft versions of the updated EN-1 and EN-4 have also been considered (Department for Business, Energy and Industrial Strategy, 2021a; 2021b).

10.4.8 A review of the relevant requirements of EN-1 and EN-4 (including the draft updated versions), relating to the EIA of the gas main diversion works, identified that the requirements are not materially different to those set out in the NNNPS (Department for Transport, 2014). As such, it is considered that by meeting the

NNNPS requirements set out in Table 10.2, the requirements of EN-1 and EN-4 are also met.

National Planning Policy Framework

- 10.4.9 The National Planning Policy Framework (NPPF) was adopted in March 2012 and last updated in July 2021. The NPPF sets out the Government's planning policies for England and how these are to be applied. It is a material consideration in planning decisions. Paragraph 5 of the NPPF makes it clear that the document does not contain specific policies for Nationally Significant Infrastructure Projects and that applications in relation to Nationally Significant Infrastructure Projects are to be determined in accordance with the decision-making framework set out in the Planning Act 2008 and relevant National Policy Statements, as well as any other matters that are considered both important and relevant. However, paragraph 5 clarifies that matters considered both important and relevant to Nationally Significant Infrastructure Projects may include the NPPF.
- 10.4.10 Section 15 of the NPPF, titled 'Conserving and enhancing the natural environment', indicates that planning policies and decisions should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan).
- 10.4.11 Paragraph 183 of the NPPF states:
- 'Planning policies and decisions should ensure that:*
- a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);*
 - b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
 - c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.'*
- 10.4.12 The aim of the NPPF is to ensure that there are no unacceptable risks to the receptors relevant to Part IIA of the Environmental Protection Act 1990, or to others that may be covered by other regimes, taking into account the proposed new land use.

Local policy

- 10.4.13 In addition to the national policy set out in the NNNPS, the proposed scheme has also had regard to relevant local plans and policy. A summary of the local policy framework is provided in Appendix 1.1 of the Environmental Statement [TR010060/APP/6.3].
- 10.4.14 Local policy relevant to geology and soils is shown in Table 10.3.

Table 10.3 Local policy relevant to geology and soils

Stakeholder	Policy	Comments
Braintree District Council	<p>Local Plan Review, Written Statement, Policy RLP 64: Contaminated land (Braintree District Council, 2020)</p> <p>An applicant proposing development on or near a site where contamination may exist should carry out a thorough investigation, so as to establish the nature and extent of the contamination. Results should be submitted to the District Council as part of the planning application.</p> <p>Local Development Framework Core Strategy, Policy CS8: Natural environment and biodiversity (Braintree District Council, 2022)</p> <p>Development should protect the BMV agricultural land.</p> <p>Publication Draft Local Plan, Policy LPP73 (Braintree District Council, 2017)</p> <p>Proposals for development on, or adjacent to land which is known to be potentially affected by contamination, or land which may have a particular sensitive end use, or involving the storage and/or use of hazardous substances, will be required to submit an appropriate assessment of the risk levels, site investigations and other relevant studies, remediation proposals and implementation schedule prior to, or as part of any planning application.</p>	<p>In line with these policies, a GI has been undertaken for the proposed scheme to establish the nature and extent of land contamination in locations where potential sources of land contamination were identified within the study area.</p> <p>A summary of the land contamination assessment undertaken is included in Section 10.8 of this chapter, and in full in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].</p>
Maldon District Council	<p>Maldon District Approved Local Development Plan 2014 – 2029, Policy D2: Climate Change & Environmental Impact of New Development (Maldon District Council, 2017)</p> <p>Where appropriate, development will include measures to remediate land affected by contamination and locate development safely away from any hazardous source.</p> <p>Development must take into account the economic and other benefits of preserving the best and most versatile land. Where possible poor quality land should be prioritised over higher quality land.</p>	<p>The proposed route corridor for the Cadent gas main diversion lies within Maldon District Council administrative boundary. In line with the Local Development Plan, the land quality assessment and GI undertaken for the proposed scheme covers the route corridor and the GI data has been utilised in the design. Whilst the policy of prioritising development on poorer quality land over BMV land, the route selection of the Cadent gas main diversion considered many variables and practicalities.</p>

Stakeholder	Policy	Comments
Chelmsford City Council	<p>Chelmsford Local Plan 2013–2036, Policy DM30 – Contamination and pollution (Chelmsford City Council, 2020)</p> <p><u>Hazardous Substance Sites or Land</u></p> <p>For developments on, or near to, hazardous substance sites or land which is contaminated or has a history of a potentially contaminating use, permission will only be granted where the Council is satisfied that:</p> <ul style="list-style-type: none"> there will be no threat to the health or safety of future users or occupiers of the site or neighbouring land; and there will be no adverse impact on the quality of local groundwater or surface water. <p>Chelmsford Local Plan 2013–2036, Strategic Policy S4 – Conserving and enhancing the natural environment</p> <ul style="list-style-type: none"> The Council will seek to minimise the loss of the BMV agricultural land (grades 1, 2 and 3a) to major new development. 	<p>The soil, groundwater and soil leachate chemical analysis data obtained as part of the GI have been screened against generic screening criteria for soils and relevant screening criteria for controlled waters. This was to determine if there are unacceptable risks to human health and controlled water receptors likely to be affected by any contamination exposed during construction of the proposed scheme.</p> <p>The screening results are included in Section 10.8 of this chapter, and in full in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].</p> <p>The predicted loss of BMV agricultural land has been quantified in this chapter, and mitigation options have been identified to mitigate temporary effects on agricultural land.</p>
Colchester Borough Council	<p>Local Development Framework, Development Policies, Policy DP1: Design and Amenity (Colchester Borough Council, 2014)</p> <p>Policy DP1 states that PPS23 (Planning and Pollution Control) provides guidance on pollution, including land contamination assessments. Colchester's approach to dealing with the development of land that could be contaminated is set out in 'Land Affected by Contamination: Technical Guidance for Applicants and Developers, 2nd edition' (Essex Contaminated Land Consortium Jan 2004) (a 3rd edition of this document was released in 2014).</p> <p>This document describes the approach to assessing land contamination, 'Site characterisation consists generally of Phase 1 and 2 investigations. The objective of these is to establish a risk assessment to enable the applicant and the regulators to clearly define the risk of harm to existing and proposed end users and other environmental receptors from contamination.'</p>	<p>A Phase 1 desk study assessment of the proposed scheme, summarised in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3], was undertaken to identify potential land contamination constraints. This was followed up by a GI (Phase 2) to establish the nature and extent of land contamination in locations where potential sources of land contamination were identified within the study area.</p> <p>A summary of the land contamination risk assessment undertaken is included in Section 10.8 of this chapter, and in full in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].</p>

Stakeholder	Policy	Comments
	<p>The Publication Draft stage of the Colchester Borough Local Plan 2017 – 2033, Policy ENV5: Pollution and Contaminated Land (Colchester Borough Council, 2017)</p> <p>Development proposals on contaminated land, or where there is reason to suspect contamination, must include an assessment of the extent of contamination and any possible risks. The onus is on the applicant to demonstrate that there is no likely risk to health or the environment due to contamination. Where planning permission is granted, conditions may be imposed requiring the execution of any necessary remedial works. Where a site is affected by land contamination, responsibility for securing a safe development rests with the developer and/or landowner, who will be required to carry out the above. After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990.</p>	

10.5 Assessment methodology

Assessment scope

- 10.5.1 The matters that are scoped into this assessment are shown in Table 10.4 below. This scope is in line with the Scoping Opinion (Planning Inspectorate, 2021).
- 10.5.2 The physical removal and degradation of BMV soils, potentially contaminated soils affecting human health, and surface water and groundwater contamination during construction are scoped into this assessment.
- 10.5.3 Marks Tey Brickpit SSSI and the potential risk to human health for site users and the general public during operation have been scoped out of the assessment.
- 10.5.4 Although operational effects on soils, surface water and groundwater have been scoped out of the geology and soils aspect, they are scoped into the road drainage and water environment aspect in terms of potential pollution from road runoff and drainage (see Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1]).

Table 10.4 Summary of geology and soils scope

Matter	Scoped in – construction	Scoped in – operation
Geology – SSSI	x	x
Soil	✓	x
Human health – site users/general public	✓	x
Human health – construction/maintenance workers	✓	x
Human health – residential properties near landfill sites	✓	x
Groundwater and surface water from contaminated land	✓	x

General approach

10.5.5 The assessment of the potential effects on geology and soils considers legislation and policies detailed in Section 10.4 of this chapter and the following guidance:

- DMRB LA 104 Environmental Assessment and Monitoring (Highways England, 2020a)
- DMRB LA 109 Geology and Soils (Highways England, 2019)
- DMRB LA 113 Road Drainage and the Water Environment (Highways England, 2020b)
- Agricultural Land Classification: protecting the best and most versatile agricultural land. Technical Information Note TIN049 (Natural England, 2012)
- Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land (Ministry of Agriculture, Fisheries and Food, 1988)
- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009)
- Contaminated Land Risk Assessment – A Guide to Good Practice (C552) (Construction Industry Research and Information Association (CIRIA, 2001)
- Land Contamination: Risk Management (LCRM) (Environment Agency, 2020)
- Piling in layered ground: risks to groundwater and archaeology. (Environment Agency, 2006)

10.5.6 Assessment of the potential effects of the proposed scheme on geological sites was undertaken by searching the GeoEssex database for local and designated geological sites within 250m of the Order Limits as well as regionally important geological or geomorphological sites (RIGS), which are non-statutory

designated sites for geology. As none were identified within 250m of the Order Limits, they have not been further assessed.

- 10.5.7 Existing land contamination identified along the proposed scheme, which is considered as a potential constraint to the proposed development, has been assessed in line with Part IIA of the Environmental Protection Act 1990 and accompanying statutory guidance (Defra, 2012) which deals with the determination of land as 'contaminated land'; and the planning regime (NPPF), which embraces a 'suitable for use' approach to land development.
- 10.5.8 Land quality risk assessment has been undertaken based on the LCRM (Environment Agency, 2020) (included in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3]). Land quality risk assessment is used to examine the impacts of contamination upon receptors. The LCRM has been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. An important thread throughout the overall process of risk assessment is the need to formulate and develop a Conceptual Site Model (CSM) for the site, which supports the identification and assessment of contaminant linkages.
- 10.5.9 A CSM was developed as part of the initial desk-based assessment of the proposed scheme. The CSM (included in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3]) supports the identification and assessment of pollutant linkages using the source-pathway-receptor model. Development of the CSM forms the main part of a preliminary risk assessment, and the model is subsequently refined or revised as more information becomes available.
- 10.5.10 The preliminary risk assessment and CSM have been updated following the completion of the GI. The GI covered design section 1 (junction 19 to 21), design section 2 (junction 21 to 23) and design section 3 (junction 23 to 25) of the proposed scheme and was undertaken between December 2019 and July 2021.
- 10.5.11 Potential risks to human health have been assessed using the CSM and by screening soil contaminant concentrations against generic soil screening criteria for assessment of risk to human health from land contamination. The screening criteria used are the Category 4 Screening Levels for the assessment of land affected by contamination, published by CL:AIRE (2014) in partnership with Defra, and Suitable for Use Levels for Human Health Risk Assessment, published by Land Quality Management and the Chartered Institute of Environmental Health in 2015. Details are provided in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].
- 10.5.12 Similarly, potential risks to controlled waters have been assessed using the CSM and by screening monitoring data against relevant screening criteria. Groundwater chemical analysis results were screened against Environmental Quality Standards (EQS) taken from the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (annual average values for freshwater) and the Drinking Water Standards (DWS) taken from the Water Supply (Water Quality) Regulations 2016. Soil leachate chemical analysis results were also screened against EQS and DWS.

- 10.5.13 It should be noted that the EQS for five metals (copper, lead, manganese, nickel and zinc) are for bioavailable concentrations of the metals calculated using the metal bioavailability tool and a separate lead screening tool. The bioavailable metal concentration is calculated from four input parameters: the dissolved metal concentration, pH, calcium and dissolved organic carbon concentrations measured in groundwater. The screening results, including the exceedances recorded and the calculated bioavailable concentrations, are presented in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].
- 10.5.14 The screening results for soil, soil leachate and groundwater are presented and discussed in Section 5.5 (main scheme) and Section 6 (borrow pits) of Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3]. Details of the risk assessment and updated CSM are also presented in Appendix 10.1.

Assessing the significance of effects

- 10.5.15 The general approach to assessing the significance of effects is set out in Chapter 5: Environmental assessment methodology, of the Environmental Statement [TR010060/APP/6.1] and is based on DMRB LA 104 Environmental Assessment and Monitoring (Highways England, 2020a).
- 10.5.16 The criteria that have been used to assess the value (sensitivity) of receptors and magnitude of impacts are based on those in Table 3.11 and Table 3.12 (including supplementary Table E/2.1) of DMRB LA 109 (Highways England, 2019). The magnitude of impact on surface water and groundwater are based on DMRB LA 113 (Highways England, 2020b). The magnitude of impact criteria used are presented in Table 10.5. The value (sensitivity) of receptors, along with the relevant criteria, is presented in Table 10.12 (in Section 10.8 of this chapter).
- 10.5.17 The significance of effects has been determined by combining the sensitivity of geology and soils receptors with the magnitude of impacts. In accordance with DMRB LA 109, the significance matrix in DMRB LA 104 (which is replicated in Chapter 5: Environmental assessment methodology [TR010060/APP/6.1]) has been used to assist professional judgement when determining the significance of effects.
- 10.5.18 Large and very large effects are considered 'significant' for the purposes of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Moderate effects are described as potentially being material in the decision-making process. Moderate effects are therefore also typically considered to be significant.

Table 10.5 Magnitude of impacts criteria

Magnitude of impact (change)	Typical description
Major	<p>Geology: loss of geological feature or designation and/or quality and integrity, severe damage to key characteristics, features or elements.</p> <p>Soil: physical removal or permanent sealing of >20ha of soil resource or agricultural land.</p> <p>Contamination:</p> <ul style="list-style-type: none"> Human health: significant contamination identified. Contamination levels significantly exceed background levels and generic screening criteria¹ (e.g. Category 4 Screening Levels) SP1010 with potential for significant harm to human health. Contamination heavily restricts future use of land. Surface water: use magnitude criteria in DMRB LA 113: <ul style="list-style-type: none"> Failure of both acute-soluble and chronic-sediment related pollutants in Highways England Water Risk Assessment Tool (HEWRAT) and compliance failure with EQS values Calculated risk of pollution from a spillage $\geq 2\%$ annually (spillage assessment) Loss or extensive change to a fishery Loss of regionally important public water supply Loss or extensive change to a designated nature conservation site Reduction in water body WFD classification Groundwater: use magnitude criteria in DMRB LA 113: <ul style="list-style-type: none"> Loss of or extensive change to an aquifer Loss of regionally important water supply Potential high risk of pollution to groundwater from routine runoff - risk score >250 (Groundwater quality and runoff assessment) Calculated risk of pollution from spillages $\geq 2\%$ annually (spillage assessment) Loss of or extensive change to groundwater dependent terrestrial ecosystem (GWDTE) or baseflow contribution to protected surface water bodies Reduction in water body WFD classification Loss or significant damage to major structures through subsidence or similar effects

Magnitude of impact (change)	Typical description
Moderate	<p>Geology: partial loss of geological feature or designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.</p> <p>Soils: physical removal or permanent sealing of 1ha to 20ha of soil resource or agricultural land, or permanent loss or 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).</p> <p>Contamination:</p> <ul style="list-style-type: none"> • Human health: contaminant concentrations exceed background levels and are in line with limits of generic screening criteria (e.g. Category 4 Screening Levels). Significant contamination can be present. Control or remediation measures are required to reduce risks to human health and make land suitable for intended use. • Surface water: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> - Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values - Calculated risk of pollution from spillages $\geq 1\%$ annually and $< 2\%$ annually - Partial loss in productivity of a fishery - Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies - Contribution to reduction in water body WFD classification • Groundwater: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> - Partial loss or change to an aquifer - Degradation of regionally important public water supply or loss of significant commercial/industrial/agricultural supplies - Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250 - Calculated risk of pollution from spillages $\geq 1\%$ annually and $< 2\%$ annually - Partial loss of the integrity of GWDTE - Contribution to reduction in water body WFD classification - Damage to major structures through subsidence or similar effects or loss of minor structures

Magnitude of impact (change)	Typical description
Minor	<p>Geology: minor measurable change in geological feature or designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.</p> <p>Soils: temporary loss or 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).</p> <p>Contamination:</p> <ul style="list-style-type: none"> Human health: contaminant concentrations are below generic screening criteria (e.g. Category 4 Screening Levels). 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 DMRB LA 113: <ul style="list-style-type: none"> Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. Calculated risk of pollution from spillages $\geq 0.5\%$ annually and $< 1\%$ annually. Minor effects on water supplies. Groundwater: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> Potential low risk of pollution to groundwater from routine runoff - risk score < 150 Calculated risk of pollution from spillages $\geq 0.5\%$ annually and $< 1\%$ annually Minor effects on an aquifer, GWDTEs, abstractions and structures.
Negligible	<p>Geology: very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature or designation. Overall integrity of resource not affected.</p> <p>Soils: no discernible loss or reduction of soil function(s) that restrict current or approved future use.</p> <p>Contamination:</p> <ul style="list-style-type: none"> Human health: contaminant concentrations substantially below levels outlined in generic screening criteria (e.g. Category 4 Screening Levels). No requirement for control measures to reduce risks to human health and make land suitable for intended use. Surface water: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants) Risk of pollution from spillages $< 0.5\%$ Groundwater: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages $< 0.5\%$

Magnitude of impact (change)	Typical description
No change	<p>Geology: no temporary or permanent loss or disturbance of characteristics, features or elements.</p> <p>Soils: no loss or reduction of soil function(s) that restrict current or approved future use.</p> <p>Contamination:</p> <ul style="list-style-type: none"> • Human health: reported contaminant concentrations below background levels. • Surface water: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> - No loss or alteration of characteristics, features or elements, no observable impact • Groundwater: use sensitivity criteria in DMRB LA 113: <ul style="list-style-type: none"> - No loss or alteration of characteristics, features or elements; no observable impact
Note 1	'Generic screening criteria' have been used for soils, and 'relevant screening criteria' have been used for controlled waters.

10.6 Assessment assumptions and limitations

- 10.6.1 The assessment is based on the proposed scheme description presented in Chapter 2: The proposed scheme, of the Environmental Statement [TR010060/APP/6.1] and has taken into account the limits of deviation illustrated on the Works Plans [TR010060/APP/2.2], in order to establish a realistic worst case assessment scenario.
- 10.6.2 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 proposed scheme to be positioned at a slightly higher elevation, or brought into closer proximity to receptors, and thereby potentially result in different effects.
- 10.6.3 Notwithstanding any potential deviation, all embedded and essential mitigation measures would remain deliverable within the extents of the limits of deviation.
- 10.6.4 Additional assumptions and limitations for this assessment include the following:
- There are some areas of the Order Limits (the area of land required for the construction, operation and maintenance of the proposed scheme) where ALC survey could not be undertaken due to land access, and therefore ALC grades have been interpolated. There are also some limited areas of agricultural land where ALC grades have not been surveyed or interpolated because the Order Limits were revised after the survey was carried out (The Order Limits in Appendix 10.2: Agricultural Land Classification Survey Report [TR010060/APP/6.3] differ due to this). Some areas were intentionally omitted because the land was non-agricultural or where only minor drainage or utility connections are proposed. ALC grades were not estimated for all of these areas, where 'unsurveyed agricultural land' is

identified. Unsurveyed agricultural land accounts for 2% of all the land within the Order Limits. Non-agricultural land was identified based on aerial imagery for the purposes of this chapter, but there may be inaccuracies in this mapping. These factors are not considered to pose material limitations to the assessment.

- Impacts on soils are only considered likely to occur within the Order Limits, So the Order Limits form the study area for this matter.

10.7 Study area

- 10.7.1 While DMRB LA 109 contains guidance on how to establish the study area, it does not detail the exact distance from the Order Limits that the study area should extend to. In the absence of a defined study area in DMRB for geology and soils, a buffer of 250m around, and including, the Order Limits has been used to establish baseline conditions and identify potential impacts on receptors. This is primarily based on Guidance for the Safe Development of Housing on Land Affected by Contamination (National House-Building Council *et al.*, 2008) and is a conservative but sensible approach in the context of the proposed scheme, considering the distance over which contamination can migrate or which effects on geological features may occur.
- 10.7.2 The study area has been used to identify potential receptors which may be affected by the proposed scheme development and potential sources of land contamination associated with historical and current land uses which have been considered as potential constraints to the proposed scheme.
- 10.7.3 This study area has been used in assessing the following matters: geology, including geological designations; soil resources; and potential sources of land contamination from both current and historical land uses, including petrol stations, historical infilled land, historical landfills and other uses. In addition, potential receptors of any contamination exposed and mobilised as part of the proposed scheme development have been considered, including groundwater and any associated abstractions and surface water.
- 10.7.4 For the soil assessment, the study area is limited to soils within the Order Limits.
- 10.7.5 The proposed scheme also includes the assessment of four proposed borrow pits located within the Order Limits (as described in Chapter 2: The proposed scheme, of the Environmental Statement [TR010060/APP/6.1]). The GI of the borrow pits was undertaken in 2020 followed by a Ground Investigation Report in 2021. The findings of the GI relevant to the geology and soils assessment are included in this chapter and Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].

10.8 Baseline conditions

Baseline sources

- 10.8.1 Information on geology and ground conditions is based on site-specific data and information obtained from the British Geological Survey (BGS), Envirocheck report and Enviro Insight and Geo Insight reports, dated July 2018, from Groundsure Ltd.
- 10.8.2 The data gathered on baseline ground conditions are sourced primarily from the Preliminary Sources Study Report (PSSR) which includes information from the Envirocheck and Groundsure reports, site walkover report, and regulatory authorities' consultations undertaken in 2017. An addendum PSSR was also undertaken in 2018 which contains supplementary information between junction 24 (Kelvedon North interchange) and junction 25 (Marks Tey interchange). All relevant information from the PSSR, PSSR addendum, Envirocheck Reports and Groundsure reports has been included in this chapter and/or in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].
- 10.8.3 The following sources have been used to establish baseline conditions:
- Online BGS Geology of Britain Viewer and relevant historical borehole scans (BGS, 2021)
 - GeoEssex website (2020) - this website provides information on sites designated either as SSSI or as local geological sites within the study area
 - The MAGIC Map application (Defra, 2021)
 - The Environment Agency's Water Framework Directive Assessment Essex and South Suffolk SMP2 (Environment Agency, 2010)
 - LandIS Soilscales (Cranfield University, 2020)
 - Essex Minerals Local Plan (Essex County Council, 2014)
 - Provisional ALC (Natural England, 2020a)
 - ALC Grades – Post 1988 Survey (Natural England, 2020b)
 - Zetica's Regional Unexploded Bomb Risk Map for Essex (Zetica, no date)

Baseline information

Geology

- 10.8.4 The study area is underlain by a bedrock geology consisting of London Clay, part of the Thames Group (clay with some silts and sands). The London Clay Formation is expected to be underlain by the undifferentiated Paleogene Lambeth Group and Thanet Formation (both consisting of silts, sands and gravel) and the Cretaceous Chalk. The Thanet Sand Formation is thought to outcrop above the London Clay at Witham. The Lambeth Group is thought to outcrop at Kelvedon. The London Clay is believed to be up to 125m thick in

places, with the Chalk at a minimum depth of 50m below ground level. Existing borehole data support the depths for both the London Clay and Chalk.

- 10.8.5 The superficial geology comprises Head deposits (clay, silt and sand), glaciofluvial deposits (sand and gravel), Lowestoft Formation (formed of diamicton and sands and gravels), Brickearth and localised Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel). There are also localised deposits of glaciolacustrine materials (sand and gravel) and Kesgrave Catchment Subgroup (sand and gravel).
- 10.8.6 Areas of Made Ground, worked ground and infilled ground are within the study area associated with historic land uses. This includes infilled historic mineral sites identified in several places along the proposed scheme, and the dismantled Witham and Kelvedon branch railway lines decommissioned in the 1970s, both crossing the current line of the A12.
- 10.8.7 The GI encountered Made Ground up to 7.5m in thickness in parts of the A12 embankment (BH+RC1164A south of Witham – see Figure 10.1 [TR010060/APP/6.2]). Made Ground generally comprised either cohesive sandy gravelly clay or granular clayey sands and gravels.
- 10.8.8 There is one designated geological SSSI – Marks Tey Brickpit – located 115m north-west of junction 25, which is designated due to its geological features.
- 10.8.9 Based on the GeoEssex database, there are no local geological sites within 250m of the Order Limits. There are no other geological designated sites within 250m of the Order Limits, including RIGS which are non-statutory designated sites for geology.

Soils

- 10.8.10 The economic resource value of soil is primarily measured by its ability to support agricultural uses. This is quantified by its ALC grade, with six grades defined within the ALC of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land (Ministry of Agriculture, Fisheries and Food, 1988), as follows:
- Grade 1 (excellent quality)
 - Grade 2 (very good quality)
 - Subgrade 3a (good quality)
 - Subgrade 3b (moderate quality)
 - Grade 4 (poor quality)
 - Grade 5 (very poor quality)
- 10.8.11 The BMV agricultural land equates to grades 1, 2 and subgrade 3a of the ALC system and is the most flexible land in terms of the range of crops that can be grown, the level and consistency of yield, and the cost of obtaining yield.

- 10.8.12 Provisional ALC data for the study area show the area to be dominated by grade 2 and undifferentiated grade 3 soils, with a small area of grade 4 at the southern end. Published post-1988 ALC data are only available for small areas and mostly show grade 1, grade 2 and subgrade 3a to be present.
- 10.8.13 A detailed site-specific ALC survey has been undertaken for the proposed scheme, with the full report in Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]. Table 10.6 below summarises the ALC grades identified and Figure 10.2 [TR010060/APP/6.2] illustrates the grades.
- 10.8.14 Agricultural land was found to be predominantly of subgrade 3a and 3b quality, with local areas of grade 2. Outside the areas surveyed, the majority of the Order Limits comprises non-agricultural land (mostly previously developed land or woodland). The 'unsurveyed agricultural land' is likely to be of grade 2 to subgrade 3b quality based on existing survey data and provisional ALC data.

Table 10.6 Agricultural Land Classification grades

ALC grade/subgrade	Area (ha)	Percentage of Order Limits
Grade 2	76.2	9.1
Estimated grade 2	4.3	0.5
Subgrade 3a	227.9	27.3
Estimated subgrade 3a	89.3	10.7
Subgrade 3b	133.6	16.0
Estimated subgrade 3b	11.5	1.4
Unsurveyed agricultural land	1.6	0.2
Non-agricultural land	290.7	34.8
Total	835.2	100.0
Note: The numbers in this table differ to that in Appendix 10.2: Agricultural Land Classification Survey Report [TR010060/APP/6.3] as they have been recalculated to reflect the final Order Limits.		

- 10.8.15 Soils may also be of importance in supporting sites of ecological importance, so a high-level review of soil types has been undertaken using the Soilscales application. Soilscales conveys a summary of the broad regional differences in the soil landscapes of England and Wales. Soilscales identifies the following soil types within the Order Limits:
- Soilscale 6 – freely draining slightly acid loamy soils
 - Soilscale 8 – slightly acid loamy and clayey soils with impeded drainage
 - Soilscale 9 – lime-rich loamy and clayey soils with impeded drainage

- Soilscape 18 – slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
- Soilscape 20 – loamy and clayey floodplain soils with naturally high groundwater

- 10.8.16 None of these soil types are inherently particularly sensitive, but Table 10.7 below identifies the sites of ecological importance (designated ecological sites and non-designated priority habitats) that are intersected by or fall within the Order Limits and therefore which are scoped into the assessment. Priority habitats are assessed as broad habitat groups rather than individually due to their number. The River Chelmer local wildlife site (LWS) and eutrophic standing water priority habitats are scoped out of the assessment because soils are not considered to be important in their ecological functioning.
- 10.8.17 Baseline information for sites of ecological importance is presented in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1] and is not repeated here.

Table 10.7 Sites of ecological importance within the scope of assessment

Value or sensitivity	Designation	Name or main habitat (for priority habitats)
Medium	LWS	Riverview Meadows
		Whetmead LWS
	Local nature reserve (LNR)	Whetmead LNR
Low	Priority habitat	Hedgerows
		Lowland mixed deciduous woodland
		Wet woodland
		Wood pasture and parkland

Mining, quarrying and mineral resources

- 10.8.18 The study area is classed as a Mineral Safeguarding Area for sand and gravel and brick clay. Detailed information on mineral resources and mineral safeguarding sites present along the study area and the potential effects of the proposed scheme on mineral resources and mineral safeguarding sites are assessed within Chapter 11: Material assets and waste [TR010060/APP/6.1], Appendix 11.1: Mineral Resource Assessment [TR010060/APP/6.3] and Appendix 11.2: Mineral Infrastructure Assessment [TR010060/APP/6.3].
- 10.8.19 The design section 2 GI included locations within the study area covered by the Coleman's Farm Quarry permit.
- 10.8.20 Part of the proposed offline A12 alignment at junction 22 passes over Colemans Farm Quarry, which is an existing operational minerals site within the local Minerals Safeguarding Area for sands and gravels. The site is currently owned and operated by Brice Aggregates. It is understood that mineral extraction has

commenced within the proposed A12 corridor, and the affected section of the proposed scheme will be backfilled with an inert engineered fill on completion. Dewatering works being undertaken as part of the mineral extraction process is anticipated to temporarily lower the groundwater regime in the area, so the groundwater monitoring data already obtained as part of the proposed scheme GI works would not be representative of the natural long-term levels. Additional groundwater monitoring may be required to provide groundwater level information prior to start of the A12 construction.

- 10.8.21 Colemans Farm Quarry have submitted an application to vary conditions of consent ESS/98/21/BTE. It is currently being agreed how extant consents for the rearrangement of the quarry will coexist with the proposed scheme. Should these plans not be realised, the proposed scheme may be required to infill the quarry voids which the new A12 alignment would cross. This would be in a manner consistent with the Colemans Farm Quarry application. The consents Brice Aggregates are currently seeking, as well as the proposed scheme potentially undertaking the void infilling, have been taken into account when assessing the impact.

Historical mineral extraction sites (potentially infilled)

- 10.8.22 A number of historical mineral extraction sites have been identified within the study area. These include brickfields, gravel pits, sand pits and quarries. Some of the sites have been redeveloped and others appear to be infilled with unknown materials and are therefore considered as potential sources of land contamination in this chapter.
- 10.8.23 An infilled gravel pit has been identified in a proposed borrow pit (borrow pit J) which is understood to have been backfilled with waste materials, including suspected asbestos-containing materials (ACM).
- 10.8.24 The sites are summarised in Table 10.8 below.

Table 10.8 Potentially infilled historical mineral extraction sites

Historical mineral extraction sites	National grid reference (approximate)	Distance from proposed scheme (road footprint and borrow pits)	Current land use
Junctions 19 to 21			
Boreham House gravel pit	TL 74109 09589	20m north	Agricultural
Historical Hogwells brickfield	TL 76706 10934	On route and extends 140m to the south of the proposed scheme	Residential properties shown on the southern section of the site

Historical mineral extraction sites	National grid reference (approximate)	Distance from proposed scheme (road footprint and borrow pits)	Current land use
Historical brick works at Hatfield Peverel	TL 79755 12218	8m north	Residential (southern section). Northern section is undeveloped.
Historical sand and gravel pit at Hatfield Peverel	TL 80093 12084	150m south	Landscaped as a lake
Junctions 23 to 24			
Historical gravel pit (Ewell Hall)	TL 86451 17764	120m south	Undeveloped
Historical brickfield (Brick Kiln/Park farms)	TL 87602 18967	On route	Existing A12 built on this site. Brickfield extends from the A12 to approximately 200m south of the road
Historical sand pit (Threshelfords Farm)	TL 87546 19393	180m north	Redeveloped into Threshelfords Business Park
Borrow pit J			
Historical gravel pit	TL 86895 17714	Within borrow pit J, 360m south-east of the proposed scheme	Infilled with construction waste including suspected ACM

Landfills

- 10.8.25 There are records of historical landfills in the study area which are summarised in Table 10.9 below.
- 10.8.26 Design section 2 of the proposed scheme includes sections of the existing A12 near historical landfills. Perry Road and East of Railway Line landfills (referred to in this report as Whetmead LNR Witham landfill) are phased landfills operated in the same area immediately to the east and possibly underlying the existing A12 to the south of Witham. Another historical landfill is located at Witham – Blackwater Lane landfill – which is also adjacent to the existing A12. A section of the proposed scheme is within the historical London Road landfill near junction 25.
- 10.8.27 Limited GI was undertaken where the proposed scheme encroaches the historical Whetmead LNR Witham landfill and Blackwater Lane landfill. The GI was limited to the existing highways boundary and not the actual landfill.

10.8.28 The London Road landfill has been investigated as part of the design section 3 GI. All the soil samples tested from this location did not exceed the generic screening criteria for soil.

Table 10.9 Landfills within 250m of the proposed scheme (road footprint and borrow pits)

Landfill	National grid reference (approximate)	Waste type received (see notes)	Operation date including operator	Distance from proposed scheme	Current use
East of Railway Line	TL 83050 13850	Industrial, commercial and household	1964–1974 Witham Urban District Council	Adjacent and possibly underlying the A12	Whetmead LNR and A12 highway
Perry Road*		Industrial, commercial and liquids/sludge	1977–1990 Witham Urban District Council		
Blackwater Lane	TL 82757 13831	Household and hazardous	1958–1964 Operator unknown	Adjacent and possibly underlying the A12	Partially undeveloped, sewage treatment works and A12 highway
Perry Way (Witham) Also named Maldon Road in the Envirocheck report	TL 82751 14283	Industrial, commercial and liquids/sludge	1963–1964 Witham Urban District Council	170m east	Warehouse in Witham Industrial Estate
London Road (near junction 25)	TL 92373 24035	Land infilled with material from Stanway by-pass construction	1960–1972 Operator unknown	Adjacent and possibly underlying the A12	Field with some pavement used as a car boot sale site and A12 highway
Foundry Lane	TL 92914 24150	Inert, household and industrial	1958–1980 Operator unknown	150m south	Residential properties

* Although the Scoping Opinion stated that the Environment Agency records indicate that the historical Perry Road landfill took hazardous waste, feedback from subsequent consultation with the Environment Agency indicates industrial, commercial and household waste in this landfill. All these waste categories may include hazardous wastes. Waste definitions and categories at the time of landfilling do not correspond to current definitions.

Potential sources of contamination

- 10.8.29 The study area is predominantly in a rural setting consisting of mostly agricultural land use. Most of the industrial activity is focused on Chelmsford and Witham. The A12 originally followed the path of the old Roman Road, with the road being constructed on its current route in the 1960s. In addition to the landfill sites and potentially infilled former brick pits and quarries noted in the above sections, there are further potentially contaminative land uses in the study area, as follows:
- Railway infrastructure including the Witham and Kelvedon branch lines shown on the late 19th century maps and decommissioned sometime in the 1970s, both crossing the current line of the A12.
 - Sewage works, including an existing sewage works at Witham which extends on both sides of the existing A12, including parts of Whetmead LNR; an existing sewage works 300m south of Rivenhall End; and a former sewage works, which is now a pumping station, near the confluence of the River Blackwater and Domsey Brook.
 - Rifle ranges dating back to the late 19th and early 20th centuries including one to the north-east of Boreham, 250m north of the A12, and one near junction 22 (Colemans interchange), 250m south of the A12.
 - A malt house and gasometer adjacent to Marks Tey Station approximately 50m north of the proposed scheme (early 19th century; gasometer demolished by 1900, Malthouse converted to warehouse in the 1960s and demolished with the construction of the A12).
 - Current and former industrial areas, including Springfield Industrial Estate, constructed in the 1970s and still present immediately west of junction 19 (Boreham interchange); a depot immediately south-west of Hatfield Peverel Station which was built in the 1960s; works of unknown purpose constructed in Boreham in the 1970s, 250m south-east of the current A12; Witham industrial area located between the A12 and the Witham branch line, which included an 'industrial gas works'; and a gas governor built adjacent to Little Braxted Lane.
 - Fuel stations including those immediately adjacent to the A12 at junctions 19, 21, at Rivenhall End, junction 23 (Kelvedon South interchange) and junction 25.
 - Two grade 2 'significant' pollution incidents have occurred within 250m of the existing A12. One was located 200m north-west of junction 22 and was of alcohols/aldehydes/other organics to water and occurred in 1997. The other was of oils and fuels to water 150m west of the A12, on Stepfield in Witham between junctions 21 and 22 and occurred in 2014.
- 10.8.30 The potential sources of land contamination listed above are shown on Figure 10.1 [TR010060/APP/6.2].

Soil assessment

- 10.8.31 Soil samples were collected for chemical analysis in the laboratory as part of the GI to determine the extent of ground contamination potentially caused by historical and current land uses along the A12 and to assess the suitability of site-won soils and materials within the proposed borrow pit areas for reuse on the proposed scheme.
- 10.8.32 Based on the chemical analysis of soil samples taken during the GI, no significant contamination has been identified across the proposed scheme between junction 19 and junction 25. Only six samples, of which two were tarmacadam samples, breached the human health screening criteria for commercial or industrial land use out of 475 soil samples tested as part of the GI including the proposed borrow pit sites. Samples were analysed for various determinands including inorganics, metals, semi-metalloids, total petroleum hydrocarbons (TPHs) and polycyclic aromatic hydrocarbons (PAHs). Selected samples were analysed for volatile and semi-volatile organic compounds (VOC and SVOC) and benzene, toluene, ethylbenzene and xylene (BTEX).
- 10.8.33 The locations listed in Table 10.10 recorded various PAHs in soils above the generic screening criteria. Sample locations are shown on Figure 10.1 [TR010060/APP/6.2].
- 10.8.34 A total of 93 soil samples were collected from the four proposed borrow pits and analysed for various determinands. Concentrations of all the determinands recorded are below the human health generic screening criteria for soils for commercial or industrial end use in all the samples tested. This indicates that soils excavated from the borrow pits could be used during the construction of the proposed scheme subject to the CL:AIRE Definition of Waste: Development Industry Code of Practice (DoWCoP) (CL:AIRE, 2011).

Table 10.10 Locations with PAHs exceeding soils screening criteria

Location ID	Location description	Depth (metres below ground level)	Proposed works at location	Geological formation (description)
WS1435B	A12 southbound, south of Witham. Figure 10.1 sheet 3 of 8 [TR010060/APP/6.2]	0.50–0.80	Embankment widening	Made Ground (sandy gravelly silt)
WS1429A	A12 northbound, east of Hatfield Peverel. Figure 10.1 sheet 3 of 8 [TR010060/APP/6.2]	0.82–0.92	Existing cutting	Made Ground (tarmacadam)
BH+RC1106	A12 northbound, Hatfield Peverel. Figure 10.1 sheet 2 of 8 [TR010060/APP/6.2]	0.40–0.50	Embankment widening	Made Ground (tarmacadam)
		0.90–1.00	Embankment widening	Glaciofluvial deposits (slightly gravelly silty sand)
BH+RC3206	A12 northbound, north-east of Kelvedon. Figure 10.1 sheet 6 of 8 [TR010060/APP/6.2]	0.20–0.40	Embankment widening	Made Ground (sandy gravelly silty clay)
BH3021	A12 southbound, east of Kelvedon. Figure 10.1 sheet 7 of 8 [TR010060/APP/6.2]	0.20–0.40	Construction of new roundabout	Made Ground (sandy gravelly clay)

10.8.35 A preliminary waste soil classification was also undertaken for all the soil samples tested using HazWaste Online, a programme which enables waste characterisation of soil based on chemical analysis in accordance with the Environment Agency (2021) Technical Guidance WM3, Waste Classification – Guidance on the classification and assessment of waste (1st Edition v1.2.GB). This assessment classifies each sample as either ‘Hazardous’ or ‘Non-Hazardous’.

10.8.36 Soil samples exceeding the hazardous waste threshold, and which may therefore not be suitable for reuse on the proposed scheme unless remediated, are summarised in Table 10.11 below and shown on Figure 10.1 [TR010060/APP/6.2]. Full details are presented in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].

Table 10.11 Soil samples exceeding the WM3 hazardous waste guideline values

Location ID	Depth range (mbgl)	Description (geological formation)	Hazardous determinand	Result (mg/kg)	Location relative to the proposed scheme	Proposed earthworks at location
BH+RC11 06	0.90–1.00	Brown slightly gravelly silty fine to coarse sand. Gravel is angular to subrounded flints. (Glaciofluvial Deposits)	TPH (C6 – C40)	3,880	Station Road, Hatfield Peverel	Material unlikely to be excavated at this location, other than to tie in new pavement layers.
BH+RC11 78	3.20–3.40	Stiff locally very stiff grey slightly sandy gravelly silty clay. Gravel is subangular to rounded flint, brick, concrete, glass and ceramic tile. Occasional carbonaceous traces including charcoal. (Made Ground)	Lead (lead compound with the exception to those specified in HazWaste annex – worst case)	1,600	Westbound on-slip, junction 19	Low strength Made Ground may be excavated as part of the proposed realignment at junction 19.
			Zinc (zinc oxide)	4,800		
WS1402	0.20–0.40	Yellowish brown very sandy subangular to rounded fine to coarse flint gravel. (Made Ground)	TPH (C6 – C40)	1,230	Eastbound carriageway, junction 19	No widening of the mainline proposed at this location.

Location ID	Depth range (mbgl)	Description (geological formation)	Hazardous determinand	Result (mg/kg)	Location relative to the proposed scheme	Proposed earthworks at location
WS1435B	0.50–0.80	Dark brown sandy gravelly silt with occasional rootlets and rare flint and tarmac cobbles (up to 80mm). Gravel is subangular and subrounded fine to coarse flint, quartzite, tarmac and brick. (Made Ground)	TPH (C6 – C40)	1,435	Westbound carriageway, south of Witham	Proposed embankment widening at this location. Materials may be removed and replaced beneath the proposed earthwork footprint.
WS1437B	0.20–0.30	Soft brown slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse brick, flint and tarmacadam. (Made Ground)	TPH (C6 – C40)	2,160	Westbound carriageway, south-east of Witham	Proposed embankment widening at this location. Materials may be removed and replaced beneath the proposed earthwork footprint.
	0.50–0.60	Light yellowish brown slightly silty gravelly fine and medium sand. Gravel is angular and subangular fine to coarse brick, flint and tarmacadam. (Made Ground)	TPH (C6 – C40)	1,240		
BH+RC22 01A	0.45–0.55	Light brown very sandy subangular fine to coarse flint, tarmacadam and concrete gravel. (Made Ground)	TPH (C6 – C40)	2,130	Westbound carriageway, south-east of Witham	Bridge abutment to be widened at location. Removal of material may be required.

Location ID	Depth range (mbgl)	Description (geological formation)	Hazardous determinand	Result (mg/kg)	Location relative to the proposed scheme	Proposed earthworks at location
BH3024	2.80–2.90	Asphalt (~25mm) over slightly sandy gravel with low subrounded concrete cobble content. Gravel is multi-coloured angular to subrounded fine to coarse flint, concrete and black probable asphalt. (Made Ground)	TPH (C6 – C40)	1,168	Eastbound carriageway, junction 24	Proposed cutting widening at this location. Materials may be removed beneath the proposed earthwork footprint.
BH3045	0.50–0.80	Blackish brown slightly gravelly slightly clayey silty sand with abundant tile and brick (up to 70mm) and occasional rootlets. Gravel is subangular to rounded fine to coarse flint, sandstone and coal. (Made Ground)	Asbestos	1,660	Old London Road; side road near junction 25	Replacement of existing side road. Material may need to be removed from area to tie into the existing pavement.

Asbestos

- 10.8.37 Limited GI of an area of historical infilled land at borrow pit J revealed the presence of suspected asbestos cement sheets and other waste materials. The presence of asbestos fibres has not been confirmed.
- 10.8.38 Cement-bound asbestos was identified within the Made Ground in BH3045 located at Old London Road, near Marks Tey Roundabout. This was identified in the laboratory as chrysotile asbestos.

Ground gas assessment

- 10.8.39 Potential sources of ground gases, including historical landfill sites and infilled land, have been identified within the study area where investigated as part of the GI.

- 10.8.40 Gas monitoring standpipes were installed in selected locations with screening zones targeting mainly Made Ground. Six ground gas monitoring rounds (at weekly intervals) were undertaken after the GI works to provide information on the ground gas regime in the monitored locations and to enable assessment of potential risks to human health.
- 10.8.41 The monitoring undertaken recorded limited flow rates and low concentrations of harmful ground gases across the proposed scheme. Methane concentrations are well below the lower explosive limit (LEL) of 5% volume by volume¹. As the ground works are expected to take place in open, well-ventilated areas, hazardous conditions are unlikely to occur.
- 10.8.42 Available ground gas monitoring data indicate that methane levels recorded in the monitored borrow pit boreholes are below the LEL. The ground gas risk assessment undertaken shows that all four proposed borrow pits have low gas-generating potential in the monitored locations. Proposed works within the borrow pits would involve open excavations – confined spaces are unlikely to be created. The monitoring results are presented and discussed in detail in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].

Surface water and groundwater

- 10.8.43 There is the potential that contaminants from contaminated land and landfills exposed during the proposed scheme development works may impact on groundwater and surface water. Information on surface water and groundwater receptors are covered in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1]. To avoid duplication, this section does not describe the water environment baseline, as Chapter 14 provides a full description of the baseline conditions.

Groundwater quality assessment

- 10.8.44 As part of the GI, groundwater quality assessment was undertaken to assess the chemical quality of the groundwater underlying the study area and the borrow pits to provide baseline data which will be used to monitor the impact, if any, of the proposed scheme on controlled waters during and after construction works.
- 10.8.45 A total of 166 groundwater samples were collected from the area affected by the proposed scheme (including the borrow pits) and analysed for various determinands including inorganics, metals, semi-metalloids, TPHs and PAHs. Selected samples were analysed for VOCs and SVOCs and BTEX.
- 10.8.46 Locations where various determinands are recorded in groundwater above the screening criteria are shown on Figure 10.1 [TR010060/APP/6.2]. The analytical data showing exceedances of screening criteria adopted are presented and discussed in detail in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].

¹ Volume/volume percentage (v/v percent) is a measure of the concentration of a substance in a solution/gas. It is expressed as the ratio of the volume of the solute/gas to the total volume of the solution/gas multiplied by 100

- 10.8.47 The results indicate that there are elevated concentrations of various contaminants in groundwater beneath the study area.
- 10.8.48 Chemical analysis of groundwater samples collected across the borrow pits recorded concentrations of various contaminants above the adopted controlled water screening criteria. This indicates that groundwaters underlying most of the borrow pits have possibly already been impacted by the potentially contaminative historical on-site and off-site land uses surrounding the sites. The contaminants recorded are mainly metals and inorganics.
- 10.8.49 Groundwater within the superficial deposits at the proposed scheme (including the borrow pits) may be in hydraulic continuity with surface water features. Therefore, there is a potential for contaminants to migrate to off-site surface waters.

Soil leachate assessment

- 10.8.50 As part of the GI, soil leachate samples were taken to assess the potential for the soil to act as a source of contamination to controlled waters.
- 10.8.51 Leachable substances were recorded above the screening criteria in most of the samples collected from the proposed scheme including the borrow pits. The locations are shown on Figure 10.1 [TR010060/APP/6.2] and the screening results are presented and discussed in detail in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].
- 10.8.52 Based on the soil leachability analysis there is potential for the soils within the borrow pits and some parts of the proposed scheme to act as a source of contamination to surface water and groundwater. A site-specific Detailed Quantitative Risk Assessment (DQRA) will be required at detailed design stage and incorporated into the earthworks specification.

Surface water monitoring

- 10.8.53 Monitoring of surface watercourses likely to be impacted by the proposed scheme was undertaken in 2018 to obtain baseline water quality information prior to the proposed scheme development works.

Future baseline

- 10.8.54 Cumulative effects are covered in Chapter 16: Cumulative effects assessment, of the Environmental Statement [TR010060/APP/6.1]. Overall, all planned developments are considered unlikely to significantly change the future baseline for geology and soils.

Geology

- 10.8.55 Due to the extensive mineral extractions in the study area and potential for new extraction licences to be approved in the future, it is likely that the current superficial sand and gravel deposits would be removed in some areas and backfilled with engineering fill. The geology is unlikely to change.

Soil

- 10.8.56 Future developments in the study area could further reduce the extent of agricultural land within the study area.

Surface water and groundwater

- 10.8.57 Any future land use changes, for example a new oil depot or garage introduced in the study area, would potentially impact groundwater and surface water quality in the area. Existing ground conditions would generally improve (particularly groundwater and surface water quality) in areas where existing and historical land contamination sources identified along the route are remediated.

Value and sensitivity of receptors

- 10.8.58 All receptors within the baseline have been assigned a value based on criteria in DMRB LA 109 (Highways England, 2019) and using professional judgement. Table 10.12 summarises the value of receptors identified within the study area.

Table 10.12 Value of receptors in the study area for geology and soils

Value	Receptor	Description	Examples within the study area
Very high	Geology	Internationally designated sites of geological value (e.g. UNESCO World Heritage Sites).	None identified within the study area.
	Human health	Very sensitive land use such as residential or allotments.	Residential properties close to the historical landfills at Witham (Blackwater lane and Whetmead LNR Witham landfill) and near junction 25 (London Road landfill).
	Soil	ALC grades 1 and 2. Soils directly supporting an EU designated site (e.g. special area of conservation (SAC) or special protection area (SPA)).	ALC grade 2 land has been surveyed within the Order Limits. No EU designated sites.
	Groundwater quality	Principal bedrock and superficial aquifers. Groundwater flow and yield associated with licensed groundwater abstractions. Groundwater quality associated with SPZ1 (inner Source Protection Zone) associated with licensed abstractions.	Upper and Middle Chalk (however, located at depth underlying the study areas). SPZ1 associated with Inworth Road groundwater abstraction (this was dropped from Environment Agency licencing in 2016, see Section 10.11 of this chapter). Various licensed abstractions, e.g. LGA-1, LGA-2 (refer to Appendix 14.4: Groundwater assessment, of the Environmental Statement [TR010060/APP/6.3]).

Value	Receptor	Description	Examples within the study area
		Water feeding GWDTEs with a high or moderate groundwater dependence, a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs.	No receptors of this value within the study area.
	Surface water quality	Watercourse having a WFD classification shown in a River Basin Management Plan (RBMP) with a $Q95 \geq 1.0 \text{ m}^3/\text{s}$.	No receptors of this value within the study area.
High	Geology	Rare and of national importance with little potential for replacement (e.g. geological SSSI).	Marks Tey Brickpit SSSI near junction 25.
	Human health	High sensitivity land use such as public open space.	Playfield located 20m south of the proposed scheme at junction 25 (former London Road landfill); recreation grounds (e.g. Marks Tey and Beaulieu Park recreation ground); village greens and local areas of recreational value; sports grounds (e.g. golf courses open to the public).
	Soil	ALC subgrade 3a. Soils directly supporting a UK designated site (e.g. SSSI).	ALC subgrade 3a land has been surveyed within the Order Limits.
	Groundwater quality	Groundwater flow, yield and quality associated with extensive non-licensed private water supplies (i.e. feeding 10 or more properties or supplying large farming/animal estates). Groundwater quality associated with SPZ2 (Outer Protection Zone) associated with licensed abstractions.	Secondary A aquifers: Glaciofluvial ice contact deposits, Alluvium, River Terrace Deposits, Kesgrave Catchment Subgroup, Lambeth Group and Thanet Sand. Default SPZ2 associated with licensed abstractions such as LGA-1 and LGA-2. (this was dropped from Environment Agency licencing in 2016, see Section 10.11 of this chapter).

Value	Receptor	Description	Examples within the study area
		Water feeding GWDTEs of low groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately GWDTE with a national non-statutory UK Biodiversity Action Plan priority.	No receptors of this value within the study area.
	Surface water quality	Watercourse having a WFD classification shown in an RBMP with a Q95<1.0m ³ /s.	River Chelmer, River Blackwater, Roman River, Boreham Brook/tributary, Domsey Brook, River Brain, River Ter.
Medium	Geology	RIGS with limited potential for replacement	None in the study area.
	Human health	Medium sensitivity land use such as commercial or industrial.	Users of commercial properties and industrial areas located throughout the study area.
	Soil	ALC grade 3b. Soils supporting non-statutory designated sites (e.g. LNRs).	ALC subgrade 3b land has been surveyed within the Order Limits. Two LWSs and one LNR have been identified within the Order Limits.
	Groundwater quality	Aquifer providing water for agricultural or industrial use with limited connection to surface water. Secondary B or Secondary Undifferentiated aquifer.	Lowestoft Formation (see Chapter 14: Road drainage and the water environment [TR010060/APP/6.1] for further examples).
		Groundwater quality associated with SPZ3 (catchment Source Protection Zone) associated with licensed abstractions and with licensed abstractions for which no SPZ is defined.	SPZ3 north of the proposed scheme.
		Groundwater flow, yield and quality associated with small-scale private water supplies (i.e. feeding fewer than 10 properties).	Private groundwater abstractions such as PGA-1, PGA-2, etc (refer to Section 2 of Appendix 14.4 [TR010060/APP/6.3]).

Value	Receptor	Description	Examples within the study area
		Water feeding GWDTEs of low groundwater dependence with a national non-statutory UK Biodiversity Action Plan priority; or water feeding highly or moderately groundwater dependent GWDTE sites with no conservation designation.	GWDTE such as Wet Woodland 7 and Riverview Meadows LWS.
	Surface water quality	Watercourse not having a WFD classification shown in an RBMP and a $Q95 > 0.001 \text{ m}^3/\text{s}$.	Rivenhall Brook, Ordinary Watercourses 13, 14, 16, 19, 32 and 37 (see Chapter 14: Road drainage and the water environment [TR010060/APP/6.1]).
Low	Geology	Geology of local importance or interest with potential for replacement (e.g. non-designated geological exposures, former quarries or mining sites).	Historical mineral extraction sites.
	Human health	Low-sensitivity land use such as highways and rail.	Great Eastern Main Line railway line runs parallel to the proposed scheme. It is located approximately 30m north of the proposed scheme between junction 19 and junction 20a (Hatfield Peverel South interchange).
	Soil	ALC grades 4 and 5. Soils supporting non-designated notable or priority habitats.	None surveyed within the Order Limits. Several priority habitats have been identified within the Order Limits including wet woodland.
	Groundwater quality	Very poor groundwater quality or very low permeability make exploitation of groundwater unfeasible. No active groundwater supply.	Unproductive strata, Peat, Interglacial lacustrine deposits, London Clay.
		Water feeding GWDTEs of low groundwater dependence with no designation or groundwater that supports a wetland not classified as a GWDTE, although may receive some minor contribution from groundwater.	GWDTE such as Marshy Grassland 1 and Wet Woodland 1, and Brockwell Meadows LNR.

Value	Receptor	Description	Examples within the study area
	Surface water quality	Watercourse not having a WFD classification shown in an RBMP and a $Q95 \leq 0.001 \text{ m}^3/\text{s}$.	Ordinary Watercourses 1 to 12, 12a, 13a, 15, 15a, 17, 18, 20, 21, 21a 23, 24, 26, 28, 31, 31b, 33 to 36, 36b, 37b, 38 to 42 (see Chapter 14: Road drainage and the water environment [TR010060/APP/6.1]).
Negligible	Geology	No geological exposures, little or no local interest.	None within the study area.
	Human health	Undeveloped surplus land/no sensitive land use proposed.	Undeveloped fields.
	Soil	Previously developed land formerly in 'hard uses' with little potential to return to agriculture.	A number of areas within the study area have been previously developed.
	Groundwater quality	Not applicable.	Not applicable.
	Surface water quality	Not applicable.	Not applicable.

10.9 Potential impacts

- 10.9.1 The following sections identify the potential impacts on geology, agricultural soils, human health, surface water and groundwater that may occur as a consequence of the proposed scheme during construction and operation. The potential impacts are identified in the absence of mitigation.

Construction

Geology

- 10.9.2 Effects to the Marks Tey Brickpit SSSI are unlikely, as this lies 115m outside of the footprint of the proposed scheme. There could be linkages between the site and sources of contamination exposed during construction, such as from dust or leachate, but these would be avoided through standard mitigation measures and are unlikely to be significant. Marks Tey Brickpit SSSI is therefore scoped out of the assessment as per the Scoping Opinion (Planning Inspectorate, 2021).

Soils

- 10.9.3 Soils would be affected in two ways during construction, via:
- physical removal or permanent sealing of agricultural land
 - degradation during stripping, handling and storage, through mechanisms such as compaction and smearing

- 10.9.4 Table 10.13 details the predicted areas of permanent and temporary land-take by ALC grade, noting that surveyed and estimated ALC grades have been combined in this table. It is anticipated that approximately 460ha of agricultural land, including 332ha of BMV land (excluding unsurveyed agricultural land where ALC grades are unknown), would be permanently sealed by the proposed scheme or otherwise lost to agricultural production by, for instance, the creation of borrow pits. This includes land where maintenance access must be maintained which would place restrictions on agricultural use. An additional 85ha of agricultural land, including at least 63ha of BMV land (excluding unsurveyed agricultural land where ALC grades are unknown), is anticipated to be temporarily acquired for the proposed scheme.

Table 10.13 Permanent and temporary land-take by ALC grade*

Land acquisition type	ALC grade	Area (ha)	Percentage of Order Limits
Permanent	Grade 2	69.0	8.3
	Subgrade 3a	263.5	31.6
	Subgrade 3b	126.2	15.1
	Unsurveyed agricultural land	1.5	0.2
	Non-agricultural	244.1	29.2
	Total agricultural land-take	460.2	55.1
Temporary	Grade 2	8.0	1.0
	Subgrade 3a	55.0	6.6
	Subgrade 3b	21.5	2.6
	Unsurveyed agricultural land	0.1	0.0
	Non-agricultural	46.7	5.6
	Total agricultural land-take	84.5	10.1

* The areas in this table add up to slightly more than the total area of the Order Limits due to some overlaps in the land acquisition boundaries.

- 10.9.5 Degradation of soils during stripping, handling and storage would affect topsoil displaced from the footprints of permanent development (assuming that it is stripped from the footprint of permanent development as per Section 10.10 of this chapter), and topsoils and subsoils within the wider Order Limits where temporary works occur, including the establishment and operation of compounds and haul roads.
- 10.9.6 For the gas main diversion, the effect on agricultural land would be temporary during construction and would be restored prior to operation.

Human health

- 10.9.7 Made Ground, infilled materials, and natural soils underlying the proposed scheme may have been potentially contaminated by historical and current land use activities. Disturbance of potentially contaminated soils during construction may create new pathways for exposure of construction workers and adjacent land users around the proposed scheme.
- 10.9.8 The GI and assessment of the ground gas monitoring data indicates a low potential for ground gases associated with the existing historical London Road landfill at junction 25 to migrate to residential properties close to the proposed scheme. Further GI of the historical Whetmead LNR Witham landfill is being undertaken at the time of writing this report to further delineate the landfill waste and assess potential risks to human health receptors.

Groundwater and surface water

- 10.9.9 The GI identified elevated contaminant concentrations in groundwater beneath the proposed scheme and the borrow pits. As such, dewatering of excavations and discharging during construction could cause harm to the aquatic environment.
- 10.9.10 Earthworks associated with the proposed scheme could create new pathways for contaminants that could detrimentally impact groundwater.
- 10.9.11 Leaching of contaminants from soils during excavation, transport, storage and emplacement could negatively impact groundwater.
- 10.9.12 The GI undertaken close the historical landfills at Whetmead LNR Witham landfill was within the existing highway boundary and did not encounter landfill materials. However, soil material collected in one of the locations was found to be hazardous based on hydrocarbon content. Groundwater quality was also poor as exceedances of relevant screening criteria were recorded. Further GI of the Whetmead LNR Witham landfill is being undertaken at the time of writing this report to further delineate the landfill waste and assess potential risks to groundwater and surface water receptors.
- 10.9.13 The GI of London Road landfill also did not encounter landfill materials. Therefore, it is considered unlikely that any landfill materials would be disturbed during the construction phase at the London Road landfill which could negatively impact controlled waters. However, previously unknown contamination that is disturbed from landfills along the proposed scheme may cause an increase in leaching of soils and mobilising of contaminants along new or existing surface or sub-surface pollution pathways. This may lead to the quality of surface waters and groundwater aquifers being impacted through runoff, infiltration and sub-surface movement.

Operation**Geology**

- 10.9.14 No additional impacts are predicted on geology during the operational phase. Operational effects on geology are therefore scoped out of further assessment.

Soils

- 10.9.15 No additional impacts are predicted on soils during the operational phase. The permanent loss of agricultural land occurring during construction would persist during operation but is not considered as an additional effect. Operational effects on soils are therefore scoped out of further assessment.

Human health

- 10.9.16 On completion of the construction phase, the proposed scheme would comprise mainly hardstanding. Contamination within the proposed scheme would have been removed during construction, reducing the potential for contact with contaminated soil. Impacts on human health during operation have therefore been scoped out of further assessment.

Groundwater and surface water

- 10.9.17 During the operational phase, potential contaminated land linkages would have been broken due to the construction of the road. Impacts to surface water and groundwater from contaminated land during operation are therefore scoped out of the geology and soils assessment.
- 10.9.18 There is potential for the proposed scheme to act as a pathway for future contamination sources, such as pollution incidents as a result of fuel and chemical leaks or spills on the new highway by road users. Effects from road runoff, drainage, and pollution incidents are scoped into the assessment and are covered in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1] (and therefore have not been assessed in the geology and soils aspect).

10.10 Design, mitigation and enhancement measures

Embedded (design) mitigation

- 10.10.1 The environment team has worked in close collaboration with the infrastructure design team to avoid or reduce environmental impacts through the proposed scheme design. This is referred to as embedded (or design) mitigation. Chapter 3: Assessment of alternatives, of the Environmental Statement [TR010060/APP/6.1] details the design alternatives that have been considered, including the environmental factors which have influenced the decision making.
- 10.10.2 Embedded mitigation relevant to this aspect is as follows:
- Consolidated development footprints to reduce the loss of agricultural land, such as reducing the length of the offline bypass between junction 22 and junction 23.
 - Embankment widening south of Witham and adjacent to the historical landfills is dependent on the extent of the Whetmead LNR Witham landfill. GI and risk assessments during the detailed design will inform the appropriate design options for the embankment widening.

Standard mitigation

- 10.10.3 Standard mitigation would occur as a matter of course due to legislative requirements or standard sector practices. Examples of standard mitigation for this aspect are detailed below.

Land contamination management

- 10.10.4 The following measures apply with respect to managing risks from land contamination:
- Pollution prevention measures, e.g. to prevent mobilisation of soil contaminants to surface waters.
 - A Materials Management Plan (MMP) (or earthworks plan) for reuse of materials under the CL:AIRE DoWCoP would be developed and implemented based on the MMP in the first iteration Environmental Management Plan (EMP) [TR010060/APP/6.5]. The MMP would detail any safeguards required for soils reuse, storage and transportation. Reuse of fill materials may require remedial treatment and will be developed with the MMP for the CL:AIRE DoWCoP declaration.
 - To avoid impacts to sensitive receptors from any land contamination exposed during construction, risk assessment and method statements would be completed as part of the construction phase with reference to controls identified within the first iteration EMP [TR010060/APP/6.5].
 - A Detailed Quantitative Risk Assessment (DQRA) is required for the management and potential treatment of any dewatering at major excavations for proposed cuttings, widenings and borrow pits and to support environmental permitting requirements for discharge to surface water bodies or back to groundwater through a groundwater recharge arrangement.
 - Areas of hazardous materials (such as asbestos) identified in the ground investigation would inform the detailed design, and where necessary remedial treatment or disposal would be undertaken where identified through the detailed design.

Soil management

- 10.10.5 The following measures apply to topsoils, and subsoils to be restored to agricultural land or reused in shallow landscaping (i.e. upper 1m of final landform).
- Guidance on soil handling set out within the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009) would be followed where practicable.
 - Prior to any soil stripping, a soil resource survey would be undertaken, including appropriate soil sampling and laboratory analyses to inform landscaping. The design of this survey would be informed by and supplement the ALC survey report for the proposed scheme (Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]).

- A Soil Resource Plan completed in accordance with the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009). This would include interpretation of the results of the soil resource survey and ALC survey with respect to landscaping and would help identify sustainable reuses for soil resources disturbed by the proposed scheme. Pre-disturbance soil horizon thicknesses and soil types would be identified in the plan.
- Appropriate supervision of soil management would be put in place to ensure that soils are handled in accordance with good practice.
- Biosecurity risks would be identified in advance of soil stripping via consultation, and good practice measures put in place as applicable, to reduce the potential for soil-borne disease and pathogen transfer between different areas of agricultural land. This may include segregation of soils and cleaning/disinfection of machinery where appropriate.
- The full depth of topsoil would be stripped from areas to be disturbed by construction, such as where haul roads, compounds and subsoil stockpiles are to be located, and from areas where topsoil would otherwise be sealed by permanent development (hardstanding and materials placement). This soil would be sustainably reused within the proposed scheme or elsewhere wherever practicable.
- Topsoil and subsoil would only be handled or trafficked when the surface is free of standing water and not frozen. Soils will only be handled when they are in a reasonably dry and friable state, below the plastic limit.
- Vegetation would be cleared from any areas to be stripped of soil and wherever topsoil or subsoil would be stored. Areas to be used for storing subsoils or other materials would first be stripped of topsoil.
- Topsoils and subsoils, as well as soils of distinctly different types or composition (as determined by the Soil Resource Plan) would be stripped separately and segregated during storage and reinstatement.
- Topsoils and subsoils would be stockpiled as close to where they were stripped from as practicable, outside root protection areas and at least 10m from any watercourses.
- Soil would be transported directly to its stockpile location after stripping, and once the stockpile has been formed, the soil would remain in the stockpile until it is reused at its final destination. Interim stockpiles would not be used, unless unavoidable, to reduce double-handling of soils.
- The stockpiles would have slopes of 1 in 2 (approximately 25°) or less and be shaped to create a mounded form that facilitates the shedding of rainwater and prevents surface water ponding.
- Stockpile heights would not exceed 4m for topsoil and 6m for subsoil but would be kept as low as practicable.

- Where soils would be stored for longer than six months, stockpiles would be seeded with an appropriate low-maintenance seed mix and measures taken to control weeds.
- The locations, volumes and contents of all stockpiles would be clearly recorded.
- Once the stockpile has been formed, the area would be cordoned off with secure fencing to prevent any disturbance by other activities. No wheeled vehicles would run on stockpiles of soil that is to be reused.
- The stockpiles would be monitored for signs of ponding, as indicated by standing water, and erosion. Where it occurs, temporary drainage measures, regrading and/or silt fencing would be put into effect.
- Where land is to be reinstated to its former use, such as for agricultural restoration, soils would be reinstated to their pre-disturbance depths and quality as far as practicable, with reference to the Soil Resource Plan.
- All surfaces to receive topsoil or subsoil would be inspected and all obstacles, such as wire, rope, wood, metal, plastic and concrete debris, and any temporary roads, surfacing or building materials, would be removed from site before the soils are reinstated.
- Appropriate cultivation and decompaction measures would be undertaken during reinstatement for topsoils, subsoils and their receiving substrates, including loosening with ripping equipment.

Environmental Management Plan

- 10.10.6 Standard mitigation is included in the Register of Environmental Actions and Commitments (REAC), within the first iteration of the EMP [TR010060/APP/6.5] which forms part of the DCO submission (refer to Chapter 5: Environmental assessment methodology, of the Environmental Statement [TR010060/APP/6.1]).

Additional mitigation

- 10.10.7 Additional monitoring of selected main rivers close to (upstream and downstream and at locations subject to available access) the proposed scheme and the borrow pits would be undertaken prior to construction to the relevant works to confirm the initial monitoring carried out in 2018 and identify changes to water quality before, during and post construction. Chemical analysis data for surface water and groundwater would be compared against values derived from a site-specific DQRA. Exceedances of the defined values would cause additional monitoring to confirm results and changes in the method of working where practicable. The groundwater and surface water monitoring programme would be included within the second iteration EMP.
- 10.10.8 Site-specific material acceptability criteria would be adopted, derived from a DQRA for any fill materials excavated from the borrow pits for placement on the proposed scheme (particularly in locations where sensitive aquifers and surface water are located).

- 10.10.9 An exclusion zone would be set up around the area of infilled land containing suspected ACM in borrow pit J and at BH3045 (close to Marks Tey roundabout) where chrysotile asbestos was identified. No works would be undertaken in this area including excavation, vehicle movements and storage to avoid ground disturbance and potential release of airborne asbestos fibres. Appropriate signage would be secured to the fencing displaying the potential risks of the area. However, if due to design requirement ground disturbance cannot be avoided (particularly at BH3045), then further risk assessment would be undertaken to determine if remediation is required.
- 10.10.10 Additional mitigation is included in the REAC, within the first iteration of the EMP [TR010060/APP/6.5].

Enhancement

- 10.10.11 No opportunities for enhancement have been identified at this stage.

10.11 Assessment of likely significant effects

Construction

- 10.11.1 An assessment of the likely significant effects during construction is described in the following sections and summarised in Table 10.14.

Geology

- 10.11.2 Construction impacts on geology have been scoped out of the assessment. No significant effects are expected.

Soils

- 10.11.3 The permanent sealing or wastage of topsoil would be avoided as far as practicable via stripping and sustainable reuse elsewhere, as per the standard mitigation measures. In addition, by following good practice soil management measures, degradation during stripping, handling and storage would either be avoided or would only be temporary (short-term) in nature; this would not likely restrict future use. Therefore, a negligible magnitude of impact is predicted for agricultural soils of medium to very high sensitivity in relation to degradation, resulting in likely **slight adverse effects** for the agricultural soil receptors during construction.
- 10.11.4 However, a permanent loss of agricultural land associated with the proposed scheme would be unavoidable, much of which would be BMV land (ALC grade 2 and subgrade 3a), which has a high to very high sensitivity. The threshold for a major magnitude of impact is >20ha, as set out in Table 10.5. As such, a major magnitude of impact would occur due to the permanent loss of approximately 460ha of agricultural land, resulting in a **very large adverse effect** due to the loss of agricultural land.
- 10.11.5 Soil quality would be degraded for topsoil displaced across the proposed scheme from sites of ecological importance, and subsoils within these areas would likely be sealed where there is a direct intersect with the permanent works. Topsoils and subsoils could also be degraded where temporary works are sited within sites of ecological importance. Standard mitigation (good

practice soil management measures, as per Section 10.10 of this chapter) would mitigate these impacts to an extent. However, the value of the topsoil for biodiversity could be permanently reduced, and the future use of the soils displaced from permanent works footprints would be restricted since it is unlikely to be possible to reuse the soils within sites of ecological importance. Moderate magnitudes of impact are predicted on soils within the majority of the affected sites of ecological importance scoped in for assessment (Table 10.7), resulting in a **moderate adverse effect** on Whetmead LWS and LNR, and **slight adverse effects** on the four types of priority habitat identified. A slight magnitude of impact is predicted on soils within Riverview Meadows LWS due to the small proportion of the site which would be affected, resulting in a **slight adverse effect** on this receptor.

Human health

- 10.11.6 The area of infilled land in borrow pit J containing the suspected ACM is unlikely to pose a significant effect on human health if the area is undisturbed. Mitigation for borrow pit J includes an exclusion zone around the suspected ACM to avoid works disturbing the area.
- 10.11.7 The available ground gas information indicates the ground gas regimes within the study area are likely to pose a low risk to human health as limited gas flow rates and low concentrations of harmful ground gases were recorded.
- 10.11.8 The GI also found there to be negligible ground gas productivity related to either the Witham or London Road landfills and is therefore unlikely to affect nearby residential properties. Further GI of the Witham landfill is planned to inform the detailed design. However, this is not expected to change this assessment.
- 10.11.9 As ground works within the borrow pits are expected to take place in open, well-ventilated areas, hazardous ground gas conditions are unlikely to build up.
- 10.11.10 Any work that is planned to take place in confined spaces during the proposed scheme construction would require a separate detailed risk assessment.
- 10.11.11 Human health receptors range from very high to negligible sensitivity across the study area. It is unlikely that soils investigated in the GI would constitute a significant risk to human health. With the correct working practices, the effect on human health of any contaminated soils encountered is likely to be negligible, resulting in a **slight adverse to neutral effect**, as impacts would be managed during construction.

Groundwater and surface water

- 10.11.12 The surface water in the study area has been monitored to provide baseline conditions.
- 10.11.13 The proposed scheme would be close to a number of rivers including the River Chelmer, Boreham Brook, River Blackwater, River Brain, River Ter, Roman River and Domsey Brook, which for the purposes of assessment have been classified as high sensitivity. With the proposed mitigation measures to prevent the mobilisation of contaminants to surface waters, the impact to the sensitive surface waters from the proposed scheme is negligible, resulting in a **slight adverse effect**.

- 10.11.14 As some of the aquifer underlying the proposed scheme is classified as SPZ1, the groundwater receptor sensitivity has been classed as very high. However, the SPZ1 only has a small area, with a diameter of approximately 100m which is centred on two abstraction boreholes. In addition, liaison with the Environment Agency confirmed that these locations were dropped from their licencing in 2016 (email 13 May 2022) and that the Environment Agency will be removing the SPZ associated with these two wells from their database. Information from the BGS indicates that the boreholes are installed within the Chalk underlying the London Clay Formation, and as such there is no foreseeable contaminant pathway from the proposed scheme to affect the abstraction wells. Given that this SPZ1 is no longer licenced this is considered to be a **neutral effect**.
- 10.11.15 The remaining groundwaters across the proposed scheme are either classified as SPZ3, Secondary A or Secondary Undifferentiated aquifers, which have been classed as medium sensitivity receptors. The construction works and the presence of existing groundwater contamination, as found in the GI, means that there could be a major adverse magnitude of impact. However, with the proposed mitigation measures to prevent the mobilisation of contaminants, the proposed scheme would have a minor magnitude impact, resulting in a **slight adverse effect**.
- 10.11.16 The proposed mitigation measures would reduce the significance of effect to surface water and groundwaters. Monitoring the water quality throughout the construction would act as an early warning and allow for further mitigation to be put in place if required.

Table 10.14 Significance categories for receptors during construction after mitigation

Receptor	Value or sensitivity	Magnitude of impact	Significance of effect
Geology (scoped out)	N/A	N/A	N/A
Agricultural soils	Very high to medium	Negligible	Slight adverse
Agricultural land	High to very high	Major	Very large adverse
Soils supporting sites of ecological importance	Medium to low	Moderate	Moderate to slight adverse
Human health	Very high to negligible	Negligible	Sight adverse to Neutral
Surface water	High	Negligible	Sight adverse
Groundwater – SPZ1	Very high	Negligible	Neutral effect (SPZ no longer licenced)
Groundwater – Secondary aquifers and SPZ3	Medium	Minor	Slight adverse

Operation

- 10.11.17 An assessment of the likely significant effects during operation is described in the following sections and summarised in Table 10.15.

Geology and soils

- 10.11.18 Operational impacts on geology have been scoped out of the assessment. No likely significant effects are expected.

Human health

- 10.11.19 Operational impacts on human health have been scoped out of the assessment. No likely significant effects are expected.

Groundwater and surface water

- 10.11.20 Operational impacts on groundwater and surface water from land contamination have been scoped out of the geology and soils assessment. No likely significant effects are expected.
- 10.11.21 Potential effects from road runoff, drainage, and pollution spillages are covered in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1] and are not addressed further in the geology and soils aspect.

Table 10.15 Significance categories for receptors during operation after mitigation

Receptor	Significance of effect
Geology	Scoped out. No significant effects are expected.
Soils	Scoped out. No significant effects are expected.
BMV agricultural land	Scoped out. No significant effects are expected.
Human health	Scoped out. No significant effects are expected.
Surface water	Scoped out. No significant effects are expected.
Groundwater	Scoped out. No significant effects are expected.

10.12 Monitoring

- 10.12.1 The proposed scheme would be close to a number of rivers. The mitigation measures suggested will reduce the significance of effect that construction would have to surface water and groundwaters.
- 10.12.2 During detailed design, a water quality monitoring programme will be developed and included within the second iteration EMP.
- 10.12.3 Monitoring surface and groundwater quality during construction would act as an early warning and allow for further mitigation to be put in place. Chemical analysis data for surface water and groundwater would be compared against values derived from a site-specific DQRA. Exceedances of the defined values would cause additional monitoring to confirm results and changes in the method of working where practicable.

10.13 Summary

- 10.13.1 A summary of likely significant effects related to geology and soils is shown in Table 10.16 below.
- 10.13.2 The requirements of the NNNPS (Department for Transport, 2014) relevant to geology and soils are met by the completion of the Land Quality Risk Assessment (included with Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3]) and consideration for the reduction in loss of BMV agricultural soils including completion of an ALC survey (included within Appendix 10.2 of the Environmental Statement [TR010060/APP/6.3]).

Table 10.16 Summary of significant geology and soils likely significant effects

Description of effect	Mitigation measures	Mitigation mechanism	Significance of effect
Construction			
Soils – loss of 460ha of agricultural land, of which 332ha comprises best and most versatile agricultural land.	Wastage of soil to be avoided as far as practicable via stripping and sustainable reuse elsewhere, as per the standard mitigation measures.	REAC, within the first iteration of the EMP [TR010060/APP/6.5]. A Soil Resource Plan will be produced prior to construction.	Very large adverse (significant)
Soils – degradation of soils supporting medium-value site of ecological importance (Whetmead LWS and LNR)	Application of good practice soil management measures as per Section 10.10 of this chapter.	REAC, within the first iteration of the EMP [TR010060/APP/6.5]. A Soil Resource Plan will be produced prior to construction.	Moderate adverse (significant)
Operation			
There would be no significant effects during operation (operational effects scoped out).			

10.14 References

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