The Sizewell C Project

6.10 Volume 9 Rail

Chapter 11 Geology and Land Quality

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Contents

Tables

Plates

None provided.

Figures

None provided.

Appendices

11 Geology and Land Quality

11.1 Introduction

11.1.1 This chapter of **Volume 9** of the **Environmental Statement** (**ES**) presents an assessment of the potential effects on geology and land quality arising from the construction and operation of proposals relating to rail.

11.1.2 The proposals considered in this volume are as follows:

- the part of the green rail route comprising a temporary rail extension of approximately 1.8km from the existing Saxmundham to Leiston branch line to the proposed B1122 (Abbey Road) level crossing (the 'proposed rail extension route') as shown on **Figure 2.1** of **Volume 9, Chapter 2** of the **ES**; and
- Saxmundham to Leiston branch line upgrades (including track replacement and level crossing upgrades) (the 'proposed rail improvement works') as shown as **Figure 2.11** of **Volume 9**, **Chapter 2** of the **ES** (together the 'proposed development').

11.1.3 The proposed rail extension route in its entirety comprises of a temporary rail extension of approximately 4.5km from the existing Saxmundham to Leiston branch line to a terminal within the main development site. The part of the green rail route between the proposed B1122 (Abbey Road) level crossing and the terminal within the main development site is detailed in **Volume 2, Chapters 1 to 4** and assessed in **Volume 2** of the **ES**.

11.1.4 Once the proposed rail extension route is no longer required for the construction of the Sizewell C Project, it would be removed and the land reinstated, however the proposed rail improvement works would be permanent.

11.1.5 Detailed descriptions of the proposed development sites (referred to throughout this volume as the 'site' as relevant to the location of the works), the proposed development and the different phases of development are provided in **Chapters 1 and 2** of this volume of the **ES**. A glossary of terms and list of abbreviations used in this chapter is provided in **Volume 1**, **Appendix 1A** of the **ES**.

11.1.6 The Government's Good Practice Guide for Environmental Impact Assessment[1] (EIA) (Ref. 11.1) outlines the potential environmental effects that should be considered for geology and land quality e.g. physical effects

1 It should be noted that this document has been withdrawn; however, it still constitutes good advice and should be referred to in the absence of alternative guidance documents

of the development, effects on geology and effects on contamination. Further information on these potential environmental effects and those which have been scoped into the geology and land quality assessment can be found in **Appendix 6N** of **Volume 1** of the **ES**.

11.1.7 This assessment has been informed by data from the following other assessments:

- **Chapter 10** of this volume: Soils and agriculture; and
- **Chapter 12** of this volume: Groundwater and surface water.

11.1.8 This assessment has also been informed by data presented in the following technical appendices:

- **Appendix 11A** of this volume**:** Green Rail Route Phase 1 Desk Study Reports;
- **Appendix 11B** of this volume**:** Conceptual site models; and
- **Appendix 11C** of this volume**:** Impact assessment tables.

11.2 Legislation, policy and guidance

11.2.1 **Appendix 6N** of **Volume 1** of the **ES**, identifies and describes legislation, policy and guidance of relevance to the assessment of the potential geology and land quality impacts associated with the Sizewell C Project across all ES volumes.

11.2.2 This section provides an overview of the legislation, policy and guidance specific to the assessment of the proposed development.

a) International

11.2.3 International legislation or policy relevant to the geology and land quality assessment includes the Water Framework Directive 2000/60/EC (Ref. 11.2) and the Waste Framework Directive 2008 (Ref. 11.3). The requirements of these, as relevant the geology and land quality assessment, are described in **Appendix 6N** of **Volume 1** of the **ES**.

b) National

11.2.4 National legislation relevant to the geology and land quality assessment includes:

- Part IIA of the Environmental Protection Act 1990 (Ref. 11.4);

- Water Resources Act 1991 (as amended) (Ref. 11.5);
- The Control of Substances Hazardous to Human Health (COSHH) Regulations 2002 (as amended) (Ref. 11.6);
- Construction (Design and Management) Regulations (CDM Regulations) 2015 (Ref. 11.7);
- Waste Management Regulations 2016 (as amended) (Ref. 11.8);
- Landfill (England and Wales) Regulations 2005 (Ref. 11.9);
- Hazardous Waste (England and Wales) Regulations 2005 (Ref. 11.10); and
- The Environmental Permitting (England and Wales) Regulations 2016 (Ref. 11.11).

11.2.5 The requirements of these, as relevant to the geology and land quality assessment, are described in **Appendix 6N** of **Volume 1** of the **ES.**

i. Planning policies

11.2.6 National Policy Statements (NPS) set out national policy for energy infrastructure. The overarching NPS for Energy (EN-1) (Ref. 11.12) and NPS for Nuclear Power Generation (EN-6) (Ref. 11.13) provide the primary policy framework within which the proposed development will be considered. A summary of the relevant planning policy, together with consideration of how this has been taken into account is provided in **Appendix 6N** of **Volume 1** of the **ES**.

11.2.7 Other national policies relevant to the geology and land quality assessment include the National Planning Policy Framework 2019 (Ref. 11.14), Planning Practice Guidance 2019 (Ref. 11.15) and the Government's 25 Year Environment Plan 2018 (Ref. 11.16). The requirements of these are described in **Appendix 6N** of **Volume 1** of the **ES.**

c) Regional

11.2.8 No regional policy is deemed relevant to the assessment of geology and land quality for this site.

d) Local

11.2.9 Volume 1, Appendix 6N summarises the requirements of Suffolk Coastal District Council (SCDC) Local Plan Core Strategy and Development Management Polices (Ref. 11.17), and SCDC Final Draft Local Plan (Ref. 11.18), as relevant to the geology and land quality assessment.

e) Guidance

11.2.10 Guidance relating to the geology and land quality assessment include:

- The Department for Environment, Food and Rural Affairs (Defra) Contaminated Land Statutory Guidance 2012 (Ref. 11.19);
- Contaminated Land Report (CLR) 11[2] (Ref. 11.20);
- Guiding Principles for Land Contamination (GPLC) (Ref. 11.21);
- The Definition of Waste: Development Industry Code of Practice (DoWCoP) (Ref. 11.22);
- The Design Manual for Roads and Bridges (DMRB) (2008) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects (Ref. 11.23);
- DMRB (1993) Volume 11, Section 3, Part 11 Geology and Soils (Ref. 11.24);
- Department of the Environment (DoE) (1995) Industry Profiles for previously developed land, Environment Agency (Ref. 11.25);
- Construction Industry Research and Information Association (CIRIA) C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice (Ref. 11.26);
- National House-Building Council and Environment Agency (2008) Guidance on the Safe Development of Housing on Land Affected by Contamination (R&D66) (Ref. 11.27);
- CIRIA C665 (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings (Ref. 11.28);
- British Standards (2015) BS 8485 +A1:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (Ref. 11.29);
- CIRIA C681 (2009) Unexploded Ordnance (UXO) – A Guide for the Construction Industry (Ref. 11.30);
- CIRIA C733 (2014) Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks (Ref. 11.31);

[2] It is noted that CLR11 is due to be withdrawn in early 2020 and replaced by updated online guidance: Environment Agency, Land contamination: Risk Management (LCRM).

- CIRIA C682 (2009) The Volatile Organic Contaminants Handbook (Ref. 11.32);
- British Standards (2015) BS 5930 – Code of practice for ground investigations (Ref. 11.33); and
- British Standards (2017) BS 10175:2011+A2:2017 – Code of Practice for Investigation of Potentially Contaminated Sites (Ref. 11.34).

11.2.11 Further detail on this guidance, as relevant to the geology and land quality assessment is set out in **Appendix 6N** of **Volume 1** of the **ES**.

11.3 Methodology

a) Scope of the assessment

11.3.1 The generic EIA methodology is detailed in **Volume 1**, **Chapter 6** of the **ES**.

11.3.2 The full method of assessment for geology and land quality that has been applied for the Sizewell C Project is included in **Appendix 6N** of **Volume 1** of the **ES**.

11.3.3 This section provides specific details of the geology and land quality methodology applied to the assessment of the proposed development and a summary of the general approach to provide appropriate context for the assessment that follows. The scope of assessment considers the impacts of the construction, operation and, where relevant, removal and reinstatement phases of the proposed development.

11.3.4 A screening exercise, as detailed below, has been undertaken for the upgrades on the level crossings on the Saxmundham to Leiston branch line which has reviewed the works proposed. Where the works are considered to have potential likely significant effects, these have been assessed. The scope of assessment considers the impacts of the proposed rail improvement works and operational use of the Saxmundham to Leiston branch line.

11.3.5 The scope of this assessment has then been established through a formal EIA scoping process undertaken with the Planning Inspectorate. A request for an EIA Scoping Opinion was initially issued to the Planning Inspectorate in 2014, with an updated request issued in 2019 as provided in **Appendix 6N** of **Volume 1** of the **ES**.

11.3.6 Comments raised in the EIA Scoping Opinion received in 2014 and 2019 have been taken into account in the development of the assessment methodology. These are detailed in **Appendices 6A** to **6C** of **Volume 1** of the **ES.**

11.3.7 The Government's Good Practice Guide[3] for the EIA states that the following potential environmental effects should be considered for geology and land quality:

- physical effects of the development: such as changes in topography, soil compaction, soil erosion, ground stability, etc.;
- effects on geology as a valuable resource: such as mineral resource sterilisation, loss or damage to regionally important geological sites, geological Sites of Special Scientific Interest (SSSIs) etc.;
- effects on soil as a valuable resource: such as loss or damage to soil of good agricultural quality;
- effects associated with ground contamination that may already exist on-site: such as introducing or changing pathways and receptors;
- effects associated with the potential for polluting substances used (during the various phase) to cause new ground contamination issues on-site, such as introducing or changing the source of contamination and, or pathways; and
- effects associated with re-use of soils and waste soils: such as re-use of site-sourced materials on or off-site, disposal of site-sourced materials off-site, importation of materials to the site etc.

11.3.8 The proposed development is considered unlikely to have an impact on important geological sites as no geological SSSIs or Local Geological Sites have been identified within the study area (described below in **section 11.3 c**). However, given the comments in the revised Scoping Opinion received in 2019 in relation to the effects on geology as a valuable resource, an assessment of effects on mineral resources has been included.

11.3.9 Physical effects in relation to changes in topography, including landscape fabric and character, are discussed in **Chapter 6** of this volume. The effects on soil as a valuable resource are discussed in **Chapter 10** of this volume. Management of site-sourced waste materials, other than site soils (i.e. general waste materials from construction, operational and removal and reinstatement phases) is summarised in **Chapter 2** of this volume, with further details provided in the **Waste Management Strategy** at **Appendix 8A** of **Volume 2** of the **ES.**

3 It should be noted that this document has been withdrawn; however, it still constitutes good advice and should be referred to in the absence of alternative guidance documents

11.3.10 Therefore, the following remaining environmental effects have been considered and form part of the assessment in this chapter:

- physical effects including soil erosion, soil compaction and ground stability;
- mineral resource loss, damage or sterilisation;
- effects associated with existing ground contamination and potential new ground contamination issues; and
- effects associated with the re-use or disposal of site sourced soils and waste soils.

11.3.11 Potential impacts from existing and new contamination sources on controlled waters have been considered as part of the geology and land quality assessment to determine and classify potential effects. Further description of the effects from contamination to groundwater and surface water is provided in **Chapter 12** of this volume.

11.3.12 This chapter provides an initial indication of chronic long-term risks to construction and maintenance workers. In accordance with the **Code of Construction Practice** (**CoCP)** (Doc Ref. 8.11)**,** short-term acute risks should be assessed, managed and mitigated by the contractor with appropriate risk assessments and methods statements (RAMS), and subsequent control measures.

b) Consultation

11.3.13 The scope of the assessment has also been informed by ongoing project wide consultation and engagement with statutory consultees throughout the design and assessment process as outlined in **Appendix 6N** of **Chapter 1** of the **ES**.

c) Environmental Screening

11.3.14 The proposed rail extension route and proposed rail improvement works have the potential to result in environmental effects which could be significant, and therefore these works have been considered in the environmental assessment.

11.3.15 An environmental screening exercise was undertaken to identify which of the eight level crossing upgrade works on the Saxmundham to Leiston branch line may give rise to environmental effects that could potentially be significant. This concluded that the eight level crossing upgrades should be screened out of the geology and land quality assessment for the proposed rail improvement works as they are not likely to give rise to significant

environmental effects. **Table 11.1** provides a summary of the environmental screening exercise.

Table 11.1: Summary of environmental screening exercise.

Proposed Level Crossing Improvement	Summary of potential effects	Screened in or out of the assessment
Bratts Black House	The minor level crossing upgrade works would involve shallow excavations only for fencing, decking and stop lights and would be undertaken generally within existing Network Rail and highway land which is being assessed. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
Knodishall	The level crossing upgrade works would involve shallow excavations only relating to the installation of automatic barriers and footways and would be undertaken generally within existing Network Rail and highway land. A temporary satellite compound is proposed to the south-west of the crossing during the construction of the crossing and is likely only required to provide welfare facilities for workers and parking for construction vehicles. The minor works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
West House	The minor level crossing upgrade works would involve shallow excavation only relating to the installation of automatic barriers and footways and would be undertaken generally within existing Network Rail and highway land. A temporary satellite compound is proposed to the south-east of the crossing during the construction of the crossing and is likely only required to provide welfare facilities for workers and parking for construction vehicles. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
Snowdens	The minor level crossing upgrade works would involve shallow excavation only for fencing, decking and stop lights and would be undertaken within existing Network Rail land. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**.	Screened out.

Proposed Level Crossing Improvement	Summary of potential effects	Screened in or out of the assessment
	Therefore, no significant effects on geology and land quality are anticipated.	
Saxmundham Road	The level crossing upgrade works would involve shallow excavation only relating to the installation of automatic barriers and footways and would be undertaken generally within Network Rail and highway land. A temporary satellite compound is proposed to the north-east of the crossing during the construction of the crossing and is likely only required to provide welfare facilities for workers and parking for construction vehicles. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
Buckles Wood	The minor level crossing upgrade works would involve shallow excavation only for fencing, decking and stop lights and would be undertaken within existing Network Rail land. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
Summerhill	The level crossing upgrade works would involve shallow excavation only for fencing, decking, anti-slip surface and stop lights and would be undertaken generally within existing Network Rail land. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.
Leiston	The level crossing upgrade works would involve shallow excavation only to upgrade the existing barriers and associated controls and signals. The works would be undertaken generally within existing Network Rail and highway land. A temporary satellite compound is proposed to the south-west during the construction of the crossing and is likely only required to provide welfare facilities for workers and parking for construction vehicles. The works would be completed in accordance with current best practice and potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods as outlined in **section 5.5**. Therefore, no significant effects on geology and land quality are anticipated.	Screened out.

d) Study area

11.3.16 To consider the physical effects of the proposed development and the effects associated with mineral resources, the re-use of soils and waste soils, the study area is defined as the area within the site boundary (the site). The site boundary of the proposed development is presented in **Chapter 1, Figure 1.1.** of **Volume 9** of the **ES**.

11.3.17 For the proposed rail extension route, the study area for the consideration of effects on human receptors, controlled waters, ecological receptors and property receptors includes the site area within the site boundary and the land immediately beyond it to a distance of 500 metres (m). The definition of the study area for the consideration of contamination effects on receptors takes into account the transport and final destination of potential contaminants of concern in the environment and the connectivity of these contaminants via pathways of migration or exposure to the receptors identified.

11.3.18 Based on the contaminated land desk study provided in **Appendix 11A** of this volume, this study area was considered sufficient for the assessment of potential land contamination and associated potential contaminant linkages (PCL)[4] risks as the land has previously undergone limited development and as such contamination, if present is likely to be limited in extent or have a limited lateral mobility if present.

11.3.19 For the proposed rail improvements, the study area for the consideration of effects on sensitive receptors includes the site area within the site boundary and land immediately beyond it to a distance of 50m.

11.3.20 The proposed rail improvement works along the Saxmundham to Leiston branch line would involve shallow excavation only for the replacement of the ballast and track and would not change the vertical alignment of the existing railway. Contamination, if present is likely to be limited in extent or have a limited lateral mobility if present. Therefore, the study area has been limited to the site and adjacent land beyond it to a distance of 50m as this is considered appropriate for the assessment based on the contaminated land desk study summarised in **section 11.3** of this chapter and provided in **Appendix 11A** of this volume.

[4] Where a linkage exists or is considered likely to be present between a potential contamination hazard/source, pathway and receptor relevant to the site.

e) Assessment scenarios

11.3.21 The assessment of effects on geology and land quality includes the assessment of the construction, operational and, where relevant, the removal and reinstatement phase of the proposed development, rather than specific assessment years.

f) Assessment criteria

11.3.22 As described in **Volume 1**, **Chapter 6** of the **ES**, the EIA methodology considers whether impacts of the proposed development would have an effect on any resources or receptors. For physical effects, and effects associated with mineral resources, waste soils and soil re-use the assessments broadly consider the magnitude of impacts and value or sensitivity of resources or receptors that could be affected in order to classify effects. For land contamination the assessment considers the change in the level of contaminative risks to the relevant receptors in order to classify effects.

11.3.23 A summary of the two assessment methods and assessment criteria used in the geology and land quality assessment is presented in the following sub-sections.

i. Physical effects, and effects associated with mineral resources, waste soils and soil re-use

11.3.24 An impact assessment of the potential physical effects of the proposed development on geology and the effects associated with mineral resources, soils re-use and waste soils has been undertaken using a qualitative approach which considers the effects of the construction, operational and removal and reinstatement phases of the proposed development on soil compaction, soil erosion, ground stability, mineral resources, potential for soil re-use and waste soil generation.

Value/sensitivity

11.3.25 The value/sensitivity of a receptor is considered when determining the consequence of an effect in the impact assessment. Where the attribute falls within two value/sensitivity criteria, the worst case value/sensitivity is selected. The value/sensitivity of soil and geological receptors has been determined using the classifications given in **Table 11.2**.

Table 11.2: Criteria for classifying the value and/or sensitivity of environmental resources/receptors.

Value / Sensitivity	Criteria	Description
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a very low capacity to accommodate the proposed change.	Regionally important mineral resource. Within a Mineral Safeguarding Area. Major ground stability, soil compaction or erosion hazards currently present at the site. High potential for soils re-use.
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a low capacity to accommodate the proposed change.	Moderately economically viable mineral resource. Adjacent to a Mineral Safeguarding Area. Moderate ground stability, soil compaction or erosion hazards currently present at the site. Moderate potential for soils re-use.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Low economically viable minerals. Low ground stability, soil compaction or erosion hazards currently present at the site. Limited opportunity for soils re-use.
Very Low	Attribute characteristics do not make a significant contribution to local character or distinctiveness. Attribute is generally tolerant and can accommodate the proposed change.	No economically viable minerals. No ground stability, soil compaction or erosion hazards currently present at the site. No opportunity for soils re-use.

Magnitude

11.3.26 Following determination of the value/sensitivity of the receptors, the magnitude of potential impacts are determined. The criteria for the assessment of impact magnitude for physical effects and effects associated with mineral resources, waste soils and soil re-use are defined in **Table 11.3**.

Table 11.3: Assessment of magnitude of impacts for physical effects and effects associated with mineral resources, waste soils and soil re-use.

Magnitude	Criteria
High	Total loss or major alterations to one or more of the key elements, features or characteristics of the baseline. The situation will be fundamentally different.
Medium	Partial loss or alteration to one or more of the key elements or characteristics of the baseline. The situation will be partially changed.
Low	Minor loss or alteration to one or more of the key elements, features or characteristics of the baseline. The change will be discernible but the underlying situation will remain similar to the baseline.

Magnitude	Criteria
Very Low	Very minor loss or alteration to one or more of the key elements, features or characteristics of the baseline, such that the change will be barely discernible, approximating to the 'no change' situation.

Effect definitions

11.3.27 The overall potential significance of the effect for physical effects and effects associated with mineral resources, waste soils and soil re-use is defined using the matrix presented below in **Table 11.4**, which describes the relationship between the value/sensitivity of the receptor as defined in **Table 11.2,** and the magnitude (change) of the potential impact as defined in **Table 11.3**.

11.3.28 Following the classification of an effect as presented in **Table 11.5**, a clear statement is made in the assessment as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

Table 11.4: Criteria for determining the significance of physical effects and effects associated with mineral resources, waste soils and soil re-use.

		Value / Sensitivity of receptor			
		Very Low	Low	Medium	High
Magnitude	Very Low	Negligible	Negligible	Minor	Minor
	Low	Negligible	Minor	Minor	**Moderate**
	Medium	Minor	Minor	**Moderate**	**Major**
	High	Minor	**Moderate**	**Major**	**Major**

11.3.29 Physical effects, and effects associated with mineral resources, waste soils and soil re-use are described as adverse/negative or beneficial/positive, considering the value of the receptor, area over which the impact may occur, whether the impact is direct or indirect, the duration of the impact (short-term: under three years, medium term: three to ten years or long-term: over ten years), and whether the impact is permanent or temporary.

11.3.30 The classifications of physical effects and effects associated with mineral resources, waste soils and soil re-use are described in **Table 11.5**.

Table 11.5: Classification of Effects.

Classification	Effect
Major adverse	Major sterilisation of mineral resources from either an active mining /quarrying site or Mineral Safeguarding Area. Major soil erosion, soil compaction or ground instability that is permanent in nature. The generation of major volumes of soils classified as hazardous waste requiring off-site disposal.
Moderate adverse	Moderate sterilisation of a mineral resource or Mineral Safeguarding Area. Moderate soil erosion, soil compaction, or ground instability that is either permanent or long-term in nature. The generation of moderate volume of waste requiring off-site disposal.
Minor adverse	Minor sterilisation of a mineral resource or Mineral Safeguarding Area. Limited medium-term soil erosion, soil compaction, or ground instability. The generation of a minor amount of waste soil requiring off-site disposal.
Negligible	No change to a mineral resource or Mineral Safeguarding Area. No measurable impact on soil erosion, soil compaction, waste volumes, or ground instability or impacts that are only temporary in nature (less than three years). No change in contamination risks.
Minor beneficial	Minor improvement in access to a mineral resource potentially facilitating future mineral extraction. Limited medium-term reduction in existing soil erosion, soil compaction, or ground instability issues. A minor amount of materials re-use on-site, thereby reducing off-site disposal volumes.
Moderate beneficial	Moderate improvement in access to a mineral resource facilitating future mineral extraction. Moderate permanent or long-term reduction in existing soil erosion, soil compaction, or ground instability issues. A moderate amount of materials reuse as part of the development, thereby reducing off-site disposal volumes by a significant extent.
Major beneficial	Major improvement in access to a mineral resource facilitating future mineral extraction. Major permanent reduction in existing soil erosion, soil compaction or ground instability issues. Sustainable reuse of materials on-site with no, or only minimal, offsite disposal of waste soils.

ii. Land contamination

11.3.31 The generic EIA methodology as described in **Volume 1, Chapter 6** of the **ES** is not used to consider the effects on land contamination from the proposed development. Instead, the assessment considers the risks to various receptors from land contamination and the change in this risk profile during construction, operation and, where relevant, removal and reinstatement. As such the magnitude of the impact is not determined, being

replaced by the change in risk level to the various receptors, which is subsequently used to define the effect.

11.3.32 The assessment of the potential impacts of the proposed development on land contamination has been undertaken over two stages including:

- Stage 1 – a land contamination risk assessment; and
- Stage 2 – a land contamination impact assessment.

Stage 1 – risk assessment

11.3.33 A Phase 1 Desk Study provided in **Appendix 11A** of this volume, was prepared for the proposed rail extension route which sets out the baseline environmental characteristics for the proposed development and study area. For the branch line upgrade works, the Phase 1 Desk Study and associated Envirocheck reports for the previous rail options and the rail extension combined with publicly available information has been utilised to develop the baseline. These Phase 1 Desk Study Reports also define the Preliminary Conceptual Site Model (PCSM).

11.3.34 Based on the PCSMs, generated for the proposed rail extension route and for the branch line upgrades, qualitative risk assessments have been undertaken in accordance with relevant guidance, as provided in **section 11.3** of this chapter, considering the potential sources, pathways and receptors present during the baseline, construction and operational phases and, for the proposed rail extension route, the removal and reinstatement phase and are included in **Appendix 11B** of this volume.

11.3.35 To assist in the risk assessment process by helping to determine the consequence of contamination being present as provided ins **section 11.3** of this chapter, a value/sensitivity has been assigned to each of the contaminated land receptors. The definition of each of these is given in **Table 11.6.**

Table 11.6: Assessment of the value or sensitivity of receptors associated with land contamination.

Value/ Sensitivity	Criteria	Description
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a very low capacity to	Principal aquifer providing potable water to a large population, within an inner or outer groundwater source protection zone (SPZ) (SPZ 1 or SPZ 2). Water Framework Directive (WFD) high status water body (surface water) providing potable water to a small population. Sensitive human health receptors, for example young children / other users of residential areas, schools and parks.

Value/ Sensitivity	Criteria	Description
	accommodate the proposed change.	Buildings, including services and foundations but of high historic value or other sensitivity, for example statutory historic designations, schools, residential dwellings. Ecological statutory designations with high sensitivity or international designations, for example Special Area of Conservation, Special Protection Area, RAMSAR etc. Crops and livestock with a high commercial / economic value.
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a low capacity to accommodate the proposed change.	Principal aquifer beyond a SPZ secondary aquifer providing abstraction water for single private potable water supplies, agricultural or industrial use. WFD good status water body (surface water). Moderate sensitivity human health receptors, for example commercial / industrial users. Buildings and infrastructure of high regional value or high sensitivity e.g. schools, hospitals, residential dwellings. Ecological statutory designations with medium sensitivity or national designations, for example SSSI, National Nature Reserve, Area of Outstanding Natural Beauty, Marine Conservation Zone (MCZ), etc. Local Geological Site or Regionally Important Geodiversity Sites etc. Crops and livestock with a medium commercial / economic value.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Secondary aquifer not currently used for groundwater abstraction. WFD moderate status (surface water). Less sensitive human health receptors, for example construction workers using mitigation measures. Buildings and infrastructure of local importance or low sensitivity (commercial / industrial buildings, main roads, railways). Ecological statutory designations with low sensitivity or sites with local designations, for example Local Nature Reserve (LNR). Crops and livestock with a low commercial / economic value.
Very Low	Attribute characteristics do not make a significant contribution to local character or distinctiveness. Attribute is generally tolerant and can accommodate the proposed change.	Non-productive strata (groundwater). WFD poor status (surface water). No sensitive human receptors. Locally important infrastructure (local roads, bridges, footpaths). Land with low sensitivity and/or non-statutory designations. No crop or livestock receptors.

11.3.36 The risk assessment then applies the principles given in the National House Building Council (NHBC) and Environment Agency report R&D66 and CIRIA C552, which provide guidance on the development and application of the consequence and probability matrix (as presented in **Table 11.7)** for contaminated land risk assessment.

11.3.37 The potential risk to a receptor is a function of the probability and the consequence of a PCL being realised. Probability (likelihood of an event occurring) takes into account both the presence of the hazard and the receptor and the integrity of the exposure pathway. Consequence takes into account both the potential severity of the hazard and the value/sensitivity of the receptor. Definitions of probability, consequence and the classified risks adopted for this assessment are detailed in **Appendix 6N** of **Volume 1** of the **ES**.

Table 11.7: Land Quality Estimation of the Level of Risk by Comparison of Consequence and Probability.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/ Low Risk
	Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

11.3.38 The descriptions of the classified risks and likely action required as given in R&D66 are detailed in **Appendix 6N** of **Volume 1** of the **ES.**

Stage 2 – Impact assessment

11.3.39 The impact assessment has been undertaken by comparing the baseline risk assessments with the construction, operation and removal and reinstatement phase risk assessments. This approach enables changes in the contaminated land status during the various phases to be identified and recorded.

Effect definitions

11.3.40 The effects of the proposed development are described as adverse/negative or beneficial/positive and major, moderate, minor or negligible on the basis of **Table 11.8**.

Table 11.8: Classification of Effects.

Classification	Effect
Major adverse	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Moderate adverse	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Minor adverse	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate to low risk.
Negligible	No change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate to low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.

11.3.41 Following the classification of an effect as presented in **Table 11.8**, a clear statement is made as to whether the effect is 'significant' or 'not significant'. Major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant.

11.3.42 It should be noted that, given the information known at the time of writing, professional judgement has been applied in certain circumstances where the introduction or removal of a receptor has automatically triggered a minor adverse or minor beneficial effect.

g) Assessment methodology

11.3.43 Detailed assessment methodologies for geology and land quality are presented in **Appendix 6N** of **Volume 1** of the **ES**. A summary is provided in the following sections.

General approach

11.3.44 The approach to the geology and land quality assessment comprises:

- establishing the baseline conditions for the study area with respect to geology, ground stability, hydrology, hydrogeology, contaminated land (including the potential for unexploded ordnance and ground gases) and historical uses;
- identification of potential impacts on identified resources and receptors from the construction, operation and removal and reinstatement phases of the proposed development;
- assessment of the significance of likely effects from the proposed development including the consideration of mitigation measures; and
- identification of any residual effects and secondary mitigation where required.

i. Establishing the baseline

11.3.45 The baseline assessment has relied on existing data, previous desk study and ground investigation reports, groundwater monitoring data, and historical records. The following sources have been reviewed:

- historical mapping and additional environmental information including historical landfill information and contemporary trade directories provided in two Envirocheck reports (which are appended to the Phase 1 Desk Study Reports) as provided in **Appendix 11A** of this volume;
- publicly available information from the British Geological Survey (BGS) (Ref. 11.35) online mapping resource;
- Suffolk County Council (SCC) Minerals Local Plan (Ref. 11.36);
- Suffolk Biodiversity Information Service website (Ref. 11.37);
- publicly available information from the Department of Environment, Food and Rural Affairs (Defra) Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref. 11.38); and
- Zetica online unexploded ordnance (UXO) risk maps (Ref. 11.39).

ii. Assessment of effects

11.3.46 An assessment of the potential physical effects of the proposed development on geology and the effects associated with soils re-use and waste soils has been undertaken using a qualitative approach considering the effects on soil

compaction, soil erosion and ground stability; mineral resources; the potential for soil re-use and waste soil generation in accordance with methods outlined in above.

11.3.47 The assessment of the potential effects of the construction, operation and, where relevant, removal and reinstatement phases of the proposed development on land contamination has been undertaken in accordance with the method outlined above.

h) Assumptions and limitations

11.3.48 The following assumptions have been made in this assessment:

- all assessment considers development within the site parameters as set out in the description of development in **Chapter 2** of this volume of the **ES** and as illustrated in **Figure 2.1** of **Volume 9, Chapter 2**;
- stockpiling of materials and the landscape bunds would stay on the land within the site. As detailed in **Chapter 2** of this volume of the **ES**, the landscape bunds would be up to 2m high and located within the fenced site area;
- vegetation, topsoil and potentially subsoil would be stripped in accordance with the **Outline Soil Management Plan (SMP)** provided in **Appendix 17C** of **Volume 2** of the **ES.**
- the use of grid connections for the construction compounds where possible to reduce the potential for storage of fuels on-site;
- the proposed rail improvement works would include the removal of existing track, ballast and sleepers and a minimal scrape of the underlying soil;
- following construction of the power station, the proposed rail extension route would be returned to agricultural use during the removal and reinstatement phase. As such underground services, tracked, other rail infrastructure and the two level crossings (Buckleswood Road and B1122 (Abbey Road)) installed along the route extension for the operation of the site would be decommissioned and removed. Apart from Lover's Lane and associated junction where the realignment is permanent, highways that have been temporarily diverted as a requirement of the proposed development would be reinstated to the original alignment. Footpaths would be generally retained in their realigned locations. Cuttings would be infilled and embankments excavated and graded for reinstatement. Topsoil would be restored in line with the **Outline SMP** provided in **Appendix 17C** of **Volume 2** of the **ES.** Permanent surface water/agricultural drains would be

reinstalled to reinstate any pre-existing field drainage systems as near as possible to pre-construction condition; and

- for the operational phase assessment, it has been assumed that all primary, tertiary and secondary mitigation measures proposed for construction have been adopted / implemented.

11.3.49 The following limitations have been identified:

- ground investigation data is not available for the majority of the proposed rail extension route or branch line upgrades sites and the baseline has been prepared using BGS mapping supplemented by eight exploratory hole logs available for the proposed rail extension route only.

11.4 Baseline environment

11.4.1 This section presents a description of the baseline environmental characteristics in the study area.

11.4.2 Further detail can also be found in **Appendix 11A** of this volume**.**

a) Current baseline

i. Rail extension route

Site visit

11.4.3 A site visit from public roads was undertaken during March 2019 to gain further information on the site setting and study area, to consider the context of the site, and to support the desk study mapping and aerial photographs.

11.4.4 The site comprises agricultural fields with the existing Saxmundham to Leiston branch line present within the south-western edge of the site. Buckleswood Road is also present in south of the site, crossing the site from north-west to south-east. No ground hazards or evidence of contamination were observed during the site visit. Further details on observations made during the site walkover including photographs can be found in the Phase 1 Desk Study Report provided in **Appendix 11A** of this volume.

Site history

11.4.5 **Table 11.9** summarises the key historical land use information of the study area. This has been compiled using an Envirocheck report as provided in **Appendix 11A** of this volume.

Table 11.9: Historical development of the proposed rail extension route site.

Map Date	Key contamination sources on-site	Key contamination sources in study area
1883 – 1885 (1:10,560)	The site is shown as predominantly fields, with a road (Buckleswood Road) and footpaths crossing the site. The Great Eastern railway (later renamed the Saxmundham to Leiston branch line) is present along the southern site boundary.	B1122 (Abbey Road) is present adjacent to the north-eastern site boundary. Abbey Lane is present adjacent to the northern site boundary. The surrounding area is occupied predominantly by farmland. Rookwood Farm is present adjacent to the northern site boundary. Two old sand pits are shown approximately 100m north-west of the site at Rookwood Farm and 300m south-west of the site at Leiston House Farm. The village of Leiston is located approximately 500m south-east of the site. A brick works and associated clay pits are present approximately 480m east of the site north of the village of Leiston.
1884 (1:2,500)	No substantial changes.	Two old sand pits are located approximately 50m north of the site at Abbey Farm.
1904 (1:2,500)	No substantial changes.	One of the old sand pits located 100m north-west of the site is no longer shown, presumably infilled.
1905 (1:10,560)	No substantial changes.	Drivers Farm is shown adjacent to the south-eastern site boundary. A new pit is present 65m to the south of the site at Johnson's Farm.
1927 (1:2,500)	No substantial changes.	No substantial changes.
1928 (1:10,560)	No substantial changes.	A pumping station is present approximately 480m south-east of the site in the area of the brick works. A cemetery is present 70m to the south of the site.
1938 (1:10,560)	No substantial changes.	A new pit is present 450m to the south-west of the site at Crossing Farm Cottages.
1950 - 1951 (1:10,560)	No substantial changes.	No substantial changes.
1957-1958 (1:10,560)	No substantial changes.	An airfield is shown 500m north-west of the site. Online information indicates this is RAF Leiston, constructed during WWII, but not shown on earlier editions of available maps.
1970 - 1971 (1:2,500)	No substantial changes.	The two old sand pits located approximately 50m north of the site are no longer shown, presumably infilled.
1975 (1:2,500)	No substantial changes.	No substantial changes.
1977 (1:10,560)	No substantial changes.	A new disused pit is shown 240m east of the site (previously marked as a small wood).

Map Date	Key contamination sources on-site	Key contamination sources in study area
		The remaining old sand pit located 100m north-west of the site and the sand pit located 300m south-west of the site are shown as disused.
1989 (1:2,500)	No substantial changes.	No substantial changes.
1995 (1:2,500)	No substantial changes.	No substantial changes.
2000 (1:10,000)	No substantial changes.	Residential properties are shown on Neale Crescent adjacent to the southern site boundary along the Saxmundham to Leiston branch line. The remaining sand and clay pits surrounding the site are no longer indicated to be present, presumably infilled.
2006 (1:10,000)	No substantial changes.	No substantial changes.
2019 (1:10,000)	No substantial changes.	No substantial changes.

Geology

11.4.6 Made Ground is not shown on the BGS online mapping, however there is potential for Made Ground to be present associated with the existing Saxmundham to Leiston branch line, roads crossing the site or other small-scale structures where present including unmapped farmer's tips. Made Ground is likely to also be present associated with the old sand pits and former clay pits that have been identified to have been located within the study area.

11.4.7 Available BGS records indicate that the majority of the site is underlain by superficial Diamicton deposits from the Lowestoft Formation, i.e. poorly-sorted matrix-supported deposits. The north-eastern parts of the site are underlain deposits of the Lowestoft Formation, which comprise an extensive sheet of chalky till as well as outwash sands and gravels, silts and clays.

11.4.8 According to the BGS website, the bedrock geology comprises sands of the Crag Group, described as 'shallow-water marine and estuarine sands, gravels, silts and clays'.

11.4.9 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that there is either no hazard or very low potential for landslides, ground stability hazards and ground dissolution stability hazards at the site and a low potential for shrinking or swelling clay. There are also no geological faults located on or within the study area.

Mineral extraction

11.4.10 The Envirocheck report provided in **Appendix 11A** of this volume indicates that the site is in an area that is unlikely to be affected by mining for coal or other mineral resources.

11.4.11 The SCC Minerals Local Plan also indicates that the site is not located within a Minerals Safeguarding Area and there are no planned areas of mineral extraction within the study area.

11.4.12 However, the Envirocheck report provided in **Appendix 11A** of this volume indicates that there are several historical pits (operation now ceased) within the study area which have been used for mineral extraction including:

- Abbey Farm sand pits (2 No.) located 50m north;
- Johnson's Farm pit (clay and shale) located 65m south;
- Rookwood Farm sand pits located 100m north-west;
- Unnamed disused pit located 240m east;
- Leiston House Farm (sand pit) located 300m south-west;
- Crossing Farm Cottages pit (clay and shale) located 450m south-west; and
- Leiston Brick Works (clay and shale) located 480m east.

Local geological sites

11.4.13 According to protected sites mapping on the Suffolk Biodiversity Information Service website the study area is not located within a geological SSSI or Local Geological Site.

Hydrogeology

11.4.14 According to the MAGIC website the superficial deposits underlying the majority of the site, associated with the Lowestoft Formation Diamicton are classified as a Secondary (Undifferentiated) Aquifer[5]. The superficial deposits in the north-eastern area of the site are classified by the

[5] A Secondary (Undifferentiated) aquifer is designated in cases where it has not been possible to attribute either category Secondary A or Secondary B to a rock type.

Environment Agency as a Secondary A Aquifer[6], associated with the Lowestoft Formation Sand and Gravel.

11.4.15 The Crag Group bedrock underlying the site is classified as a Principal Aquifer[7].

11.4.16 There are groundwater source protection zones (SPZ)[8] present within the site. The south-western section of the site lies within a groundwater SPZ 2 (Outer Protection Zone)[9] and SPZ Zone 3 (Total Catchment)[10].

11.4.17 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that there are four current licensed groundwater abstractions within the study area. The closest is located 265m south-west of the site and used for general farming and domestic use. A public potable water supply abstraction is located 390m west of the site. The remaining abstraction licenses located 365m and 430m to the east of the site are for spray irrigation and industrial processes. There is the potential for unknown Private Water Supplies (PWS) to be in use within the study area.

11.4.18 Further baseline hydrogeology information for the proposed development is provided in **Chapter 12** of this volume of the **ES.**

Hydrology

11.4.19 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that a series of ditches cross the site, which in turn feed the upper reaches of the Leiston Drain to the east of the B1122 (Abbey Road). There are no existing ponds present within the site, however, 28 ponds are recorded present within the study area.

11.4.20 Further consideration of the hydrology of the site is provided in **Chapter 12** of this volume of the **ES**.

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[6] Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
[7] Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
[8] A Source Protection Zone (SPZ) is defined around groundwater sources such as wells, boreholes and springs used for public drinking water supply, and show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment).
[9] Defined by a 400-day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 meters around the source, depending on the size of the abstraction.
[10] Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management.

Flood risk

11.4.21 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that the site is located in Flood Zone 1, and therefore has a low risk of flooding from rivers or seas without defences. Risks associated with groundwater, sewer and reservoir flooding at the site are also considered to be low. The Environment Agency's long-term flood risk mapping shows that the majority of the site is also at very low risk of flooding from surface water. However, an area of approximately 2 hectares (ha) located along the eastern boundary of the site is indicated to be at high risk of surface water flooding.

11.4.22 Further details on flood risk are provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) and in **Chapter 12** of this volume of the **ES**.

Historic and environmentally sensitive sites

11.4.23 A review of the MAGIC website indicates that Buckle's Wood which is designated as an Ancient Woodland and a Country Wildlife Site is present adjacent to the south-west of the site, with the fields on either side of Buckleswood Road described as pre-18th century enclosures.

11.4.24 Various archaeology finds have been recorded along the route corridor, including those dating from the Bronze Age, Romano-British and Medieval periods.

11.4.25 No further recorded historical or ecologically sensitive sites have been identified to be present within the study area.

11.4.26 Further consideration of designated and non-designated sites for ecology and historic environment, both statutory and non-statutory is provided in **Chapter 7** and **Chapter 9** of this volume of the **ES**.

Waste management and other permitted sites

11.4.27 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that there are several historical landfills located within 500m of the site as follows:

- Abbey Pit (infilled old sand pit) located approximately 500m to the north east of the site. The type of waste accepted at this landfill and operation dates are unknown;
- Aldhurst Farm located approximately 500m east of site. The landfill received inert, industrial, commercial and household waste and was closed in 1990. Additional information on the Environment Agency website indicates that gas control measures may have been in place at some point during the site's lifetime; and

- Carr's Pit landfill located approximately 500m east of site. This landfill received inert and industrial waste from 1976 to 1987.

Service stations

11.4.28 According to the Envirocheck report provided in **Appendix 11A** of this volume, there is one service station located within the study area, situated on Waterloo Avenue in Leiston, 420m to the south-east of the site.

Industrial and other potentially contaminative land uses

11.4.29 The Envirocheck report provided in **Appendix 11A** of this volume, indicates that there are no active trade establishments that have the potential to use contaminants of concern in their processes on or within the study area. However, it is noted that several farms are present within the study area which have the potential to use contaminants of concern.

11.4.30 The land contamination report prepared by SZC Co. for the Aldhurst Farm Habitat Creation Scheme (Ref. 11.40) states that in consultation with the Environment Agency it was confirmed that sediment from Leiston Brook and the sewage works 800m to the south east of the site is periodically spread on an area of land adjacent to Lover's Lane. Furthermore, it is noted that this material 'may contain sanitary waste'. It is not known the extent of land over which this material may be spread or whether this is still occurring.

Potential for unexploded ordnance (UXO)

11.4.31 A Zetica UXO map was obtained to assess the risk of encountering UXO at the site and is appended to the Phase 1 Desk Study Report provided in **Appendix 11A** of this volume. The map indicates that the site is within an area with a moderate risk[11] of encountering UXO. This is assumed to be associated with the airfield (RAF Leiston) located 500m north-west of the site which was constructed during WWII.

Previous ground investigations

11.4.32 Eight cable percussive boreholes were drilled within and adjacent to the proposed site boundary (GR1, GR2, GR3, GR4, GR5, GR6, GR7 and GR11) as part of a previous ground investigation undertaken for the Sizewell C Project by Structural Soils in 2014 (Ref.11.41).

[11] A recorded bomb density of between 11 and 50 bombs per 1,000 acres and that may also contain potential WWII targets. Action to mitigate the risk is considered essential, albeit more likely that a reduced scope of work is required compared with that needed for high-risk regions.

11.4.33 The boreholes were drilled to a maximum depth of 30 metres below ground level (m bgl) and encountered the following ground conditions:

- Topsoil – from surface to between 0.3m bgl and 0.6m bgl, comprising sandy gravelly Clay;
- Made Ground – encountered in one borehole (GR1) from surface to 0.4m bgl, comprising gravel sandy clay with brick and coal fragments;
- Lowestoft Formation (Diamicton) – from 0.3m bgl to a maximum depth of 8.5m bgl, comprising gravelly sandy Clay and silty fine Sand; and
- Crag Sand – from 1.9m bgl to 30m bgl (depth not proven), comprising medium and coarse dense gravelly Sand.

11.4.34 The thickness of superficial deposits was generally found to increase with distance from the coast.

11.4.35 No olfactory of visual observations of contamination were reported in the boreholes during the ground investigation.

11.4.36 Boreholes GR2, GR3, GR6 and GR11 were installed with groundwater monitoring installations within the Lowestoft Formation and Crag Sand. Groundwater levels were monitored on two occasions in March and April 2014 following the ground investigation and were recorded between 6m bgl and 16m bgl.

11.4.37 No soil samples were collected from the boreholes for environmental laboratory testing during the ground investigation and no ground gas or groundwater sampling was undertaken. There is no contamination testing data available for these exploratory holes.

ii. Rail improvement works

Site history

11.4.38 **Table 11.10** summarises the key historical land use information of the study area.

Table 11.10: Historical development of the rail improvement works site.

Map Date	Key contamination sources on-site	Key contamination sources in study area
1884 (1:2,500) 1883 – 1885 (1:10,560)	The Great Eastern railway is shown present on-site running between Leiston in the east and Saxmundham in the west with a branch of the Great Eastern railway line running north to south from the Saxmundham Junction. A station is present at Leiston.	The surrounding area comprises agricultural land with associated farms, plantations and small woodlands. The village of Leiston is present surrounding the east of the site and the town of

Map Date	Key contamination sources on-site	Key contamination sources in study area
	The line south of the Saxmundham Junction is built on an embankment. The line north of the Saxmundham Junction and the branch line running east/west are constructed within a cutting. Roads are present in their current layout crossing the Great Eastern railway. The River Fromus flows north to south through Saxmundham, crossing beneath the Great Eastern railway in the south-west of the site. An unnamed watercourse flows north to south crossing the Great Eastern railway to the west of Saxmundham road crossing in the centre of the site.	Saxmundham is present surrounding the west of the site. Roads and the Great Eastern railway are present adjacent to the north, south, east and west of the site. Sidings are present adjacent to the south of the site at Leiston. A brick field and kiln are present adjacent and 50m to the north of the site in Leiston. Two windmills (pumping and corn) are present 50m south of the site around Leiston. An unnamed pit and an old sand pit are present adjacent to the north-west (Rockwood Farm) and south-west (Leiston Farm House) of the site at the Saxmundham Road level crossing.
1904 (1:2,500) 1905 (1:10,560)	The branch line running north to south from Saxmundham Junction is now named the East Suffolk line and the railway running from east to west is named as the Aldeburgh Branch line.	A rifle range is shown located adjacent to the south-western of the site in Saxmundham. A new pit is present 50m to the south of the site at Johnson's Farm.
1927 (1:2,500) 1928 (1:10,560)	Leiston station is no longer indicated. A bridge is now present crossing the East Suffolk line 250m north of Saxmundham Junction.	Storage tanks are indicated to be present adjacent to the north of the site in Leiston. Leiston works are present 50m to the south of the site. The sidings have expanded around the area of the works. Allotments are present 50m south-west of the site around Leiston and Sizewell crossing. The brick field and kiln and windmills are no longer indicated to be present. The rifle range is no longer indicated adjacent to the south-west of the site. A miniature rifle range is indicated adjacent to the west of Saxmundham Junction. An unnamed watercourse is shown approximately 10m from the south-western boundary of the site in the location of the former rifle range.
1938 - 1951 (1:10,560)	No substantial changes.	No substantial changes.
1950 - 1951 (1:10,560)	No substantial changes.	The miniature rifle range is no longer shown west of the Saxmundham Junction.
1957-1958 (1:10,000)	No substantial changes.	No substantial changes.

Map Date	Key contamination sources on-site	Key contamination sources in study area
1970-1976 (1:2,500) 1975-1977 (1:10,000)	The unnamed watercourse crossing the railway to the west of Saxmundham road crossing is now labelled as the Hundred River.	The storage tanks are no longer indicated to be present. However, works are now indicated to be present in this area. The allotments and sand pit are no longer indicated to be present. Eastland's Industrial Estate including a factory is present adjacent to the south-east of the site. The sidings are no longer indicated adjacent to the south of the site. The unnamed pit and old sand pit present adjacent to the north-west and south-west of the site at the Saxmundham Road level crossing are now labelled as disused and the sand pit at Johnson's Farm is no longer indicated to be present, presumably infilled.
1989 (1:2,500)	No substantial changes.	The works adjacent to the north of the site are now labelled as a coal yard, gas distribution station with tanks / gasholders, a depot and electricity substation.
2000 (1:10,000)	No substantial changes.	The works adjacent to the north of the site are no longer indicated.
2006 (1:10,000)	No substantial changes.	No substantial changes.
2019 (1:10,000)	No substantial changes.	No substantial changes.

Geology

11.4.39 Made Ground is not shown on the BGS online mapping, however there is potential for Made Ground to be present associated with the existing railway, roads crossing the site or other small-scale structures where present including unmapped farmer's tips. Made Ground could also be present associated with the old sand pits located within the site vicinity.

11.4.40 Available BGS records indicate that the majority of the site is underlain by superficial Diamicton deposits from the Lowestoft Formation, i.e. poorly-sorted matrix-supported deposits. The eastern and western areas of the site are underlain by deposits of the Lowestoft Formation which comprise an extensive sheet of chalky till as well as outwash sands and gravels, silts and clays.

11.4.41 Alluvium is present within the centre of the site associated with the Hundred River. Head Deposits of Sand, Silt, Clay and Gravel, and Alluvium are

present underlying the south-west of the site in Saxmundham associated with the River Fromus.

11.4.42 According to the BGS website, the bedrock geology comprises sands of the Crag Group, described as 'shallow-water marine and estuarine sands, gravels, silts and clays'.

11.4.43 The Envirocheck reports provided in **Appendix 11A** of this volume, indicate that there is either no hazard or very low potential for collapsible ground stability hazards, ground dissolution stability hazards and landslides and a very low to low potential for running sand ground stability hazards. Compressible ground stability hazards and shrinking or swelling clay ground stability hazards are indicated to range from no hazard to moderate. There are also no geological faults located on or within the study area.

Mineral Extraction

11.4.44 The Envirocheck reports provided in **Appendix 11A** of this volume, indicate that the site is in an area that is unlikely to be affected by mining for coal or other mineral resources.

11.4.45 The SCC Minerals Local Plan also indicates that the site is not located within a Minerals Safeguarding Area and there are no planned areas of mineral extraction within the study area.

11.4.46 However, the Envirocheck reports provided in **Appendix 11A** of this volume, indicate that there are four historical pits/features (operation ceased) within the study area which have been used for mineral extraction including:

- Rookwood Farm Sand Pit located adjacent north-west;
- Leiston Farm House Sand Pit located adjacent south-west;
- Brick field and kiln (clay) located 50m south; and
- Johnson's Farm Pit (clay and shale) located 50m south.

Local Geological Sites

11.4.47 According to protected sites mapping on the Suffolk Biodiversity Information Service website the site is not located within or in proximity to a geological SSSI or LGS.

Hydrogeology

11.4.48 According to the MAGIC website the superficial deposits underlying the majority of the site, associated with the Lowestoft Formation are classified as

a Secondary (Undifferentiated) Aquifer[12]. The superficial Lowestoft Formation Sand and Gravel, Alluvium and Head Deposits are classified as Secondary A Aquifers.

11.4.49 The Crag Group bedrock underlying the site is classified as a Principal Aquifer[13].

11.4.50 The east of the site is not located within a groundwater SPZ[14]. However, the majority of the site lies within a groundwater SPZ Zone 3 (Total Catchment)[15] and the centre of the site lies within a SPZ Zone 2 (Outer Protection Zone)[16].

11.4.51 The Envirocheck reports indicate that there are no licensed groundwater abstractions within the study area.

Hydrology

11.4.52 The Hundred River crosses the centre of the site and the River Fromus crosses the south-west of the site. A number of unnamed small surface ponds and surface water drains are also located within the study area.

Flood Risk

11.4.53 The Envirocheck reports provided in **Appendix 11A** of this volume, indicate that the majority of the site is not at risk of flooding from rivers or seas without defences. The centre and south-west of the site associated with the Hundred River and River Fromus are located within a Flood Zone 2 and are indicated to have a high risk of flooding.

11.4.54 Further details on flood risk are provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) and in **Chapter 12** of this volume of the **ES.**

[12] A Secondary (Undifferentiated) aquifer is designated in cases where it has not been possible to attribute either category Secondary A or Secondary B to a rock type.
[13] Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
[14] A Source Protection Zone (SPZ) is defined around groundwater sources such as wells, boreholes and springs used for public drinking water supply, and show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment).
[15] Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management.
[16] Defined by a 400-day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 meters around the source, depending on the size of the abstraction.

Historic and environmentally sensitive sites

11.4.55 Several Grade II[17] listed buildings are indicated to be present within 50m of the site. No other sensitive land uses are indicated to be present on or within the study area.

11.4.56 A review of the MAGIC website indicates that the fields on either side of Buckleswood Road are described as pre-18th century enclosures.

11.4.57 Further consideration of designated and non-designated sites is given in **Chapter 7** and **Chapter 9** of this volume of the **ES**.

Waste Management Sites

11.4.58 The Envirocheck reports provided in **Appendix 11** of this volume, indicate that there are no historical or operational landfills located within the study area.

Service stations

11.4.59 According to the Envirocheck reports provided in **Appendix 11A** of this volume, there are no service stations located with the study area.

Industrial and other potentially contaminative land uses

11.4.60 The Envirocheck reports provided in **Appendix 11A** of this volume, indicate that there are several active trade establishments that have the potential to use contaminants of concern in their processes located within the study area as follows:

- A printing press, tyre dealer and pest and vermin control company located 50m to the south of the site in Leiston;
- Abbey Road car repair and services located 50m to the north of the site in Leiston; and
- A coach and bus station located 10m to the south-west of the site in Saxmundham.

Potential for Unexploded Ordnance (UXO)

11.4.61 Zetica UXO maps were obtained to assess the risk of encountering UXO at the site and are appended to the Phase 1 Desk Study Reports as provided in **Appendix 11A** of this volume. The maps indicate that the east of the site

[17] Grade II Listed buildings are of special interest and the vast majority of listings.

is within an area with a moderate risk[18] of encountering UXO. This is assumed to be associated with the airfield (RAF Leiston) located 500m north of the site which was constructed during WWII. The west of the site, west of Saxmundham Road level crossing is located within an area designated as having a low risk of encountered UXO.

Previous ground investigations

11.4.62 No previous ground investigations have been undertaken at the site.

b) Future baseline

11.4.63 There are several committed developments which have been identified within the study area for the proposed rail extension route and the rail improvement works as outlined in **Table 11.11**.

Table 11.11: Committed Developments.

Planning Application Ref.	Site Address	Description of development	Date of Approval	Status	Distance (m)
Rail extension route					
DC/14/3166/OUT	Abbey View Lodges Orchard House 105 Abbey Road Leiston Suffolk IP16 4TA	Application for outline planning permission with all matters reserved for redevelopment of the site for 10 dwellings.	10/04/2015	Construction commenced.	37
DC/16/1961/OUT	Johnsons Farm Saxmundham Road Leiston Suffolk	An outline planning application for up to 187 dwellings to include car parking, open space provision with associated infrastructure and access.	21/06/2017	DC/19/1883/ARM pending consideration	170
DC/16/2104/OUT	Land at The Rear of St Margarets Crescent Leiston Suffolk	Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be	29/06/2017	Construction not commenced.	252

[18] A recorded bomb density of between 11 and 50 bombs per 1,000 acres and that may also contain potential WWII targets. Action to mitigate the risk is considered essential, albeit more likely that a reduced scope of work is required compared with that needed for high-risk regions.

Planning Application Ref.	Site Address	Description of development	Date of Approval	Status	Distance (m)
		reserved except for access).			
DC/17/1617/FUL	Abbey View Lodges Orchard House 105 Abbey Road Leiston Suffolk IP16 4TA	Redevelopment of the site for 8 dwellings	16/08/2017	Construction commenced.	24
Proposed rail improvement works					
DC/17/4645/OUT	The Mill 22 Carr Avenue Leiston Suffolk IP16 4JA	Outline application for 7 dwellings comprising 2 new flats, 1 duplex unit, conversion of existing eastern range to 1 dwelling, conversion to former mill to 3 flats.	19/04/2018	Construction not commenced.	41
DC/17/3773/FUL	Land at Colonial House Station Road Leiston Suffolk	Erection 6 no. 1 bed flats	02/11/2017	Construction not commenced.	34
DC/16/5035/OUT	Part Side Garden 2 Abbey Road Leiston Suffolk	Use of land for erection of two dwellings	24/07/2017	Construction not commenced.	8
DC/16/0931/FUL	Land West of Mill Cottage Valley Road Leiston Suffolk	Erection of 18 dwellings including parking and external works.	18/08/2017	Construction not commenced.	30
DC/16/0527/OUT	Gas Works Carr Avenue Leiston Suffolk IP16 4AT	Erection of 20 dwellings with associated paths, landscaping and boundary walls, gates and fences. Re-positioning of existing vehicular access to new drive and parking area.	23/06/2017	Construction not commenced.	21

Planning Application Ref.	Site Address	Description of development	Date of Approval	Status	Distance (m)
DC/15/1760/FUL	Sizewell Crossing Industrial Estate King Georges Avenue Leiston Suffolk	Use of land for the siting of 10 self-storage containers and installation of security lighting	21/07/2015	Construction not commenced.	11

11.4.64 The construction of Abbey View Lodges has commenced, but the construction timeline for the remaining developments is unconfirmed. However, planning permissions generally require construction to commence within three years of the grant of planning permission or reserved matters upon which the planning permission lapses. As such, it has been assumed, given the nature and scale of the applications, that the developments will have been constructed prior to 2022. These developments have therefore been considered as future receptors and potential future sources of contamination as part of the baseline for the rail extension route and the rail improvement works land contamination risk assessments and within the assessment of physical effects and effects associated with mineral resources, soils re-use and waste soils.

c) Preliminary Conceptual Site Model

11.4.65 A PCSM identifies the potential or known sources of contamination, receptors and pathways between the two. Where all three are present or are considered likely to be present (source-pathway-receptor linkage), they are called a potential contaminant linkage (PCL).

11.4.66 Four PCSMs (baseline, construction, operational and, where relevant, removal and reinstatement) have been produced for the proposed development using the information summarised above. A summary of potential contamination sources are provided in **Table 11.12** and **Table 11.13**, and potential pathways and receptors identified are provided in **Table 11.14**.

Table 11.12: Existing potential sources of contamination for the rail extension.

Potential source of contamination	Potential contamination	Approximate location
Made Ground associated with the construction and operation of the existing Saxmundham to Leiston branch line and minor roads crossing the site.	A range of inorganic and organic contaminants including polyaromatic hydrocarbons (PAHs), coal tars, asbestos and ground gases. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	On-site

Potential source of contamination	Potential contamination	Approximate location
Farmland within site boundary. Potential for unmapped farmers tips.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel/engine oils. Risk of inorganic and organic contamination including metals and hydrocarbons, Polychlorinated Biphenyl (PCBs) and asbestos.	
Made Ground / fill material associated with the former pits and brick works located within 500m of the site.	Fill material is unknown but potential contaminants may include metals, inorganic and organic contaminants, fuels, oils, hydrocarbons, PCBs, asbestos and a potential for vapour and, or ground gas generation.	Off-site
Historical landfills located within 500m of the site.	Potential contaminants may include metals, inorganic and organic contaminants, fuels, oils/hydrocarbons, PCBs, asbestos and a potential for vapour and, or ground gas generation.	
Made Ground associated with the construction and operation of the adjacent railway line and roads.	A range of inorganic and organic contaminants including the potential for asbestos. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	
Farmland surrounding the site. Potential for unmapped farmers tips.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel/engine oils. Risk of inorganic and organic contamination including metals and hydrocarbons, PCBs and asbestos.	
Airfield (RAF Leiston) located 500m north-west of the site.	A range of inorganic and organic contaminants including the potential for asbestos. Fuels and oils, metals and hydrocarbons and PCBs.	
Potential spreading of sediment including sanitary waste from the Pumping station and Leiston Wastewater Treatment Works 800m south-east of the site onto fields adjacent to the site.	Potential contamination may comprise metals, inorganic contaminants, fuels and oils, PCBs, treatment chemicals, and a potential for hazard gas generation from sludges (as well as sanitary waste).	

Table 11.13: Existing potential sources of contamination for the Saxmundham to Leiston branch line.

Potential source of contamination	Potential contamination	Approximate location
Made Ground associated with the construction and operation of the existing Saxmundham to Leiston branch line, station, and minor roads crossing the site.	A range of inorganic and organic contaminants including PAHs, coal tars, asbestos and ground gases. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	On-site

Potential source of contamination	Potential contamination	Approximate location
Farmland within site boundary. Potential for unmapped farmers tips.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel/engine oils. Risk of inorganic and organic contamination including metals and hydrocarbons, PCBs and asbestos.	
Made Ground / fill material associated with the former pits and brick field located within 50m of the site.	Fill material is unknown but potential contaminants may include metals, inorganic and organic contaminants, fuels, oils, hydrocarbons, PCBs, asbestos and a potential for vapour and ground gas generation.	Off-site
Made Ground associated with the construction and operation of the adjacent East Suffolk line, sidings and roads.	A range of inorganic and organic contaminants including hydrocarbons, PCBs, PAHs, solvents and creosote; metals; asbestos, ash and fill used in the construction of the railway. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	
Farmland surrounding the site. Potential for unmapped farmers tips.	Contamination risk from herbicides, pesticides, silage, effluent, and fuel oils. Risk of inorganic and organic contamination including metals and hydrocarbons, PCBs and asbestos.	
Former rifle ranges located adjacent to the site at Saxmundham	Potential contamination may comprise a range of inorganic and organic contaminants including hydrocarbons and metals.	
Tanks, works, coal yard, gas distribution station with tanks / gasholders, depot and electricity substation located adjacent to the north of the site in Leiston	Potential contamination may comprise metals, inorganic contaminants, oils, coal tar, hydrocarbons, cyanide, ammonium, sulphurs, asbestos and other volatile organics.	
Leiston Works located 50m to the south of the site	Potential contamination may comprise a range of inorganic and organic contaminants including asbestos, hydrocarbons, PAHs, and metals.	
Former windmills located 50m south of the site in Leiston	Potential contamination may comprise a range of inorganic and organic contaminants including asbestos, hydrocarbons, PAHs and metals.	
Former allotments located 50m south-west of the site at Valley Road level crossing	Contamination risk from herbicides, pesticides, and fuel oils. Risk of inorganic and organic contamination including metals and hydrocarbons and asbestos.	
Eastland's Industrial Estate located adjacent to the south-east of the site	A range of inorganic and organic contaminants including the potential for asbestos. Fuels and oils, metals and hydrocarbons, PCBs.	
Abbey Road car service and repairs located 50m to the north of the site in Leiston and coach and bus station located	Metals and organic contaminants from petroleum, petrol additives, diesel, oils / lubricants including the potential for asbestos.	

Potential source of contamination	Potential contamination	Approximate location
10m to the south-west of the site in Saxmundham.		
Leiston Press, a tyre dealer, pest and vermin control company, Abbey Road services station and bus station located within 50m of the Saxmundham to Leiston branch line.	Risk of inorganic and organic contamination including metals, asbestos, hydrocarbons, solvents.	

Table 11.14: Potential receptors and contaminant exposure and migration pathways at baseline and resulting from the proposed development.

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Human Health (on-site)	Commuters, pedestrians, cyclists and horse riders accessing roads and public rights of way crossing the rail route	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water; and Inhalation of soil-derived dust, fibres, gas and vapours
	Farmers / workers on agricultural land	
	Construction and maintenance workers	
	Users of the existing Saxmundham to Leiston branch line	
	Users of the new railway line along the proposed rail extension route	
Human Health (off-site)	Residents in adjacent properties and users of commercial properties in the surrounding area	Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site; and Inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.
	Pedestrians, cyclists and horse riders accessing public rights of way	
	Farmers and workers on adjacent agricultural land	
Controlled Waters: Groundwater (on-site and off-site)	Groundwater within Principal Bedrock Aquifer, Secondary A and Secondary Undifferentiated Superficial Aquifers	Leaching of contaminants in soil to groundwater in underlying aquifers; and Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.
Controlled Waters: Surface waters (off-site)	The River Fromus and Hundred River and ponds and drains within the study area	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow; and Discharge of contaminants entrained in groundwater and/or surface water run-off followed by overland flow and discharge.

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Property (on-site and off-site)	Existing on-site services and structures Existing off-site services and structures Proposed on-site infrastructure and services Listed buildings and archaeological features	Direct contact of contaminants in soil and/or groundwater with existing and proposed structures and buried services; and Migration of contaminated groundwater, ground gas and, or vapours along strata and preferential pathways such as service routes or differentially permeable strata.
	Crops and livestock	Migration of contaminated waters/dust/fibres and subsequent uptake by crops or ingestion/inhalation/ dermal contact by livestock.
Ecological Receptors (off-site)	Buckle's Wood Ancient Woodland and Country Wildlife Site	Migration of contaminated waters/dust/fibres and subsequent uptake by flora or ingestion/inhalation/ dermal contact by fauna.

11.5 Environmental design and mitigation

11.5.1 As detailed in **Chapter 6** of **Volume 1** of the **ES**, a number of primary mitigation measures have been identified through the iterative EIA process and have been incorporated into the design and construction planning of the proposed development. Tertiary mitigation measures are legal requirements or are standard practices that would be implemented as part of the proposed development.

11.5.2 The assessment of likely significant effects of the proposed development assumes that primary and tertiary mitigation measures are in place. For geology and land quality, these measures are identified below, with a summary provided on how the measures contribute to the mitigation and management of potentially significant environmental effects.

a) Primary mitigation

11.5.3 Primary mitigation is often referred to as 'embedded mitigation' and includes modifications to the location or design to mitigate impacts; these measures become an inherent part of the proposed development.

11.5.4 Primary mitigation for the proposed development would include:

- the design of the proposed rail extension route and associated structures would be in accordance with the suite of Network Rail

standards and the Governance for Rail Investment Projects (GRIP) process, and best practice guidance at the time of the design;

- the proposed rail improvement works would be completed in accordance to the relevant Network Rail standards including NR/L3/ENV/044: Track maintenance, renewal or alteration- used ballast handling (Ref. 11.42);
- the design of the temporary and permanent road diversions and junction and the selection of construction materials would be in accordance with the DMRB, British Standards and best practice guidance at the time of the design;
- the selection of materials for both the proposed development would be required to take into account the ground conditions including the potential for ground movement, compaction, ground gas and ground aggressivity;
- where possible, the construction of temporary hardstanding within the primary construction compounds to reduce spills and leaks infiltrating into the ground; and
- the use of appropriate drainage systems in accordance with the **Drainage Strategy** provided in **Appendix 2A** of **Volume 2** of the **ES** to reduce the potential for contamination to migrate and impact on the ground, groundwaters and surface waters. This would include the use of lined drainage where necessary to protect the ground and underlying groundwater.

b) Tertiary mitigation

11.5.5 Tertiary mitigation will be required regardless of any EIA assessment, as it is imposed, for example, as a result of legislative requirements and/or standard sectoral practices.

11.5.6 Tertiary mitigation measures to be incorporated into the proposed development during construction, operation phases for both the proposed development upgrades and the removal and reinstatement phase of the proposed rail extension route, as set out in the **CoCP** (Doc Ref. 8.11) include:

- prior to stockpiling or other groundworks associated with the proposed rail extension route, topsoil/subsoil present would be removed and appropriately stored for potential re-use in landscaping areas, subject to demonstrating suitability for reuse criteria. This process would reduce the potential for buried topsoil to generate ground gas beneath the proposed development which may pose a risk to human health;

- development of health and safety risk assessments and method statements by the contractor (including emergency response procedures), and provision of appropriate personal protective equipment (PPE) for the protection of construction workers;
- Implementation of a contamination watching brief by suitably qualified and experienced personnel would be completed for the proposed development when excavating areas of potential contamination risk. If unidentified contamination is encountered, works will be temporarily suspended in the area and appropriate investigations and remediation will be discussed and agreed with stakeholders and completed in accordance with current best practice;
- implementation of appropriate dust suppression measures to reduce migration of contaminated dust, further details are provided in the air quality assessment provided in **Chapter 5** of this volume of the **ES**;
- minimising the area and duration of soil exposure and timely reinstatement of vegetation, ballast or hardstanding to reduce soil exposure/erosion and reduce temporary effects on soil compaction;
- stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) to reduce windblown dust and surface water run-off;
- clear segregation between stockpiled material including imported material, excavated material stockpiled for re-use and excavated waste material stockpiled for treatment and / or off-site disposal;
- covering / hydroseeding of temporary stockpiles or the landscape bunds may be completed to reduce soil erosion and dust generation;
- stockpiles would be located a minimum of 10m from the nearest watercourse;
- implementation of working methods during construction to ensure that surface water run-off from the stockpiles, landscape bunds or working area is minimised and captured prior to entry into adjacent surface watercourses or leaching into underlying groundwater in accordance with best practice;
- implementation of appropriate pollution incident control e.g. plant drip trays and spill kits and suitable training and toolbox talks completed; and

- implementation of appropriate and safe storage of fuel, oils, chemicals and equipment during construction in accordance with COSHH regulations and oil storage regulations.

11.5.7 The **CoCP** (Doc Ref. 8.11) would incorporate the information required as part of an Environmental and Social Management Plan in accordance with the Network Rail Standard NR/L2/ENV/015 (Ref. 11.43).

11.5.8 Additional tertiary mitigation that would be anticipated and referenced in the **CoCP** (Doc Ref. 8.11) includes:

- implementation of an appropriate materials management strategy to document how the excavated materials would be dealt with via Materials Management Plan(s) (MMP) and verification report(s) to record the excavation and placement of materials at the site. Further details are provided in the **Materials Management Strategy** provided in **Appendix 3A** of **Volume 2** of the **ES**;
- implementation of a site waste management plan in accordance with the **Conventional Waste Management Strategy** provided in **Appendix 8A** of **Volume 2** of the **ES** (including visual inspection of ballast during replacement works and any contaminated ballast segregated for waste purposes); and
- implementation of an outline **Soil Management Plan** provided in **Appendix 17C** of **Volume 2** of the **ES**.

11.5.9 For the operational phase, storage and disposal of wastes and hazardous substances where required would be managed in accordance with current guidance and legislative requirements.

11.6 Assessment

a) Introduction

11.6.1 This section presents the findings of the land quality and geology assessment for the construction, operation and, where relevant, removal and reinstatement phases of the proposed development.

11.6.2 This section identifies any likely significant effects that are predicted to occur and **section 11.6** of this chapter highlights the secondary mitigation and monitoring measures that are proposed to minimise any adverse significant effects (if required).

b) Construction

i. Physical effects

11.6.3 A qualitative approach has been undertaken to assess the likely physical effects of the proposed development. The effects have then been categorised in accordance with the methodology described in **Appendix 6N** of **Volume 1** of the **ES**, and summarised in **section 11.3** of this chapter, and confirmed as either temporary or permanent, adverse or beneficial and significant (moderate or major effects) or not significant (minor or negligible).

11.6.4 The construction phase of the proposed development may result in soil erosion, soil compaction and ground instability issues associated with stripping of topsoil, vegetation clearance, earthworks, stockpiling, movement of heavy plant, temporary works and construction of the proposed development, and the upgrade to the existing branch line. These effects are considered in further detail below.

Proposed rail extension route

Soil erosion

11.6.5 Earthworks, including cuttings and embankments for the proposed rail extension route, and areas for temporary works are anticipated with temporary stockpiles likely to be required on-site to allow earthworks along the railway to progress and temporary works areas/haul roads to be constructed. Landscape bunds approximately 2m high and various lengths are also proposed within the site. There is the potential for increased runoff during earthworks with a high sediment load which may impact local surface waters (further details of impacts on surface waters provided in **Chapter 12** of this volume of the **ES**). Earthworks would be managed in accordance with the **CoCP** (Doc Ref. 8.11) to minimise soil exposure as far as practicable and areas required for temporary works during the construction phase would be reinstated as soon as possible after they are no longer required. The impacts on soil erosion are therefore considered to be temporary, short-term, and direct.

11.6.6 Given the current mainly agricultural use of the site, the potential for soil erosion currently is likely to be low, the value/sensitivity of the receptor is classed as low. With primary and tertiary mitigation measures, set out in **section 11.5** of this chapter the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse (**not significant**).

Soil compaction

11.6.7 Soil compaction may arise through the earthworks and from heavy plant movements within the site. All new embankments would also need to be constructed in layers and compacted to the design requirements. Compaction of the track bed is required to attain the design stability and vertical alignment. Ground conditions indicated sands, gravels, silts and clay deposits with limited Made Ground associated with existing roads crossing the proposed development and the potential for farmers tips within the site. The impact on soil compaction during the construction phase is therefore considered to be temporary, short-term, and direct.

11.6.8 Given these ground conditions, substantial soil compaction over and above that required in the design is anticipated to be minimal. The value/sensitivity of the receptor is therefore classed as low. With primary and tertiary mitigation measures, set out in **section 11.5** of this chapter the magnitude of the impact is considered to be very low. The overall effect is therefore considered to be negligible (**not significant**).

Ground stability

11.6.9 No ground stability hazards or geological faults are recorded present within the study area. The proposed development is not within an area of coal or non-coal mining, although some small scale historical quarrying of sands and clays is recorded. However, there is a moderate UXO risk assumed to be due to the local presence of RAF Leiston to the north-west of the site. The impact on ground stability during the construction phase is therefore considered to be temporary, short-term, and direct.

11.6.10 Given the above, the value/sensitivity of the receptor is classed as medium. With primary and tertiary mitigation, the magnitude of the impact is considered to be medium. The overall effect is therefore considered to be moderate adverse (**significant)**.

Proposed rail improvement works

Soil erosion, soil compaction and ground stability

11.6.11 Minor earthworks are proposed as part of the proposed rail improvement works and would only involve very shallow excavation / surface scrapes for the removal and replacement of the existing ballast and track. The east of the site is located within an area with a moderate UXO risk assumed to be due to the local presence of RAF Leiston to the north of the site. However, the Saxmundham to Leiston branch line has been in existence prior to publication of the 1883 maps, indicating that any WWII UXO strikes along the line would have been dealt with post war. No ground stability hazards or geological faults are recorded to be present within the study area and the

proposed rail improvement works are not within an area of coal or non-coal mining. The impact on soil erosion, soil compaction and ground stability during the construction phase is therefore considered to be temporary, short-term, and direct.

11.6.12 The value/sensitivity of the receptor for the proposed rail improvement works is therefore classed as low**,** and the magnitude of the impact is considered to range between low and very low. The overall effect for soil erosion, soil compaction and ground stability is therefore considered to be negligible to minor adverse (**not significant**).

ii. Mineral resources

11.6.13 The proposed development has the potential to impact upon mineral resources and associated Mineral Safeguarding Areas through the loss, damage or sterilisation of an important mineral resource.

11.6.14 The baseline assessment indicates the presence of historical mineral extraction sites (sands, clays, etc.) within the study area. However, the site and study area are not located within a coal mining area, an area of planned mineral extraction or a Minerals Safeguarding Area. In addition, the mineral extraction sites identified within **section 11.4** of this chapter were no longer recorded present generally by publication of the maps in the 1970s. Therefore, there would be a limited impact on the current regional mineral resources. The impacts on mineral resources during the construction phase are therefore considered to be temporary, short-term and direct.

11.6.15 Given that there are limited valuable mineral resources located within the study area, the value/sensitivity of the receptor is classed as low. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources. The overall effect is therefore considered to be **negligible** (**not significant**).

iii. Effects associated with ground contamination

11.6.16 The construction PCSMs and risk assessments are presented in **Appendix 11B** of this volume and the impact assessments in **Appendix 11C** of this volume. The construction impact assessment is undertaken by comparing the baseline land contamination risks to those predicted during construction, while considering any new sources and pollution pathways introduced by construction activities.

11.6.17 The construction phase would potentially introduce new sources of contamination and disturb and mobilise existing sources of contamination. Construction activities, such as excavation may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of

preferential pathways for surface water run-off and ground gas migration. Potential changes to the baseline situation creating PCLs, which have been assessed within this chapter are:

- the potential for mobilising contaminants by excavation and stockpiling of material, increasing the risk to controlled water receptors through leaching and run-off. Earthworks could provide opportunities for run-off to contain suspended solids if not carried out in line with required management procedure;
- the potential for introducing new sources of contamination, i.e. from spillages and leaks;
- the potential for exposure of human receptors by generation of potentially contaminated dust and vapours released by the construction works; and
- the potential for creation of new pathways to groundwater during groundworks, through opening up ground temporarily and construction activities, such as earthworks, installation of drainage and other below-ground services.

11.6.18 The impacts on land contamination are considered to be permanent, long-term and direct. Primary and tertiary mitigation measures would be incorporated into the construction process as outlined in **section 11.5** of this chapter. These would include the adoption of working methods during construction to manage groundwater appropriately, implementation of appropriate pollution incident control and implementation of appropriate and safe storage of fuel, oils and equipment.

11.6.19 A summary of the construction phase PCSM and impact assessment is provided in **Table 11.15**, and includes the risks identified to the receptors. A more detailed assessment of construction risk and impact assessment is provided in Appendices 11B and 11C.

Proposed rail extension route

11.6.20 It is considered that with the primary and tertiary mitigation measures in place, risks to human health, controlled waters, ecological and property receptors during construction activities would range between very low to moderate / low risk. Compared to the existing baseline, the level of risk to receptors has generally remained the same or increased during the construction phase. An overall negligible to minor adverse effect (**not significant**) has therefore been predicted.

Table 11.15: Construction phase effects for the proposed rail extension route.

Receptor	Value / Sensitivity	Baseline risk	Construction risk	Classification of Effect
Human (on-site)	High	Receptor not present to Low	Low	Negligible to Minor adverse **(not significant)**
Human (off-site)	High	Very low	Low	Minor adverse **(not significant)**
Controlled waters: groundwater (on-site and off-site)	Medium	Low	Moderate / low	Minor adverse **(not significant)**
Controlled waters: surface water (on-site and off-site)	Low	Very low	Low	Minor adverse **(not significant)**
Property: existing and future structures and services (on-site and off-site)	Medium	Very low	Low	Minor adverse **(not significant)**
Property: crops and livestock (on-site and off-site)	Medium	Low	Low	Negligible **(not significant)**
Ecological (off-site)	High	Low	Low	Negligible **(not significant)**

Proposed rail improvement works

11.6.21 With the primary and tertiary mitigation measures in place, risks to human health, controlled waters and property receptors during construction activities would range from very low to low. Compared to the existing baseline, the level of risk to receptors has generally remained the same during the construction phase. An overall negligible to minor adverse effect (**not significant**) has therefore been predicted.

11.6.22 The risks identified to the receptors are summarised in **Table 11.16.**

Table 11.16: Construction phase effects for the proposed rail improvement works.

Receptor	Value / Sensitivity	Baseline risk	Construction risk	Classification of Effect
Human (on-site)	High	Very low	Low	Minor adverse **(not significant)**
Human (off-site)	High	Very low	Very low	Negligible **(not significant)**
Controlled waters: groundwater (on-site and off-site)	Medium	Low	Low	Negligible **(not significant)**

Receptor	Value / Sensitivity	Baseline risk	Construction risk	Classification of Effect
Controlled waters: surface water (on-site and off-site)	Low	Very low	Very low	Negligible **(not significant)**
Property: existing and future structures and services (on-site and off-site)	Medium	Very low	Very low	Negligible **(not significant)**
Property: crops and livestock (on-site and off-site)	Medium	Very low	Very low	Negligible **(not significant)**

iv. Effects associated with waste soils and soil re-use

11.6.23 Waste soils would be generated during construction through the proposed earthworks, excavations and the installation of drainage/services. There is the potential that waste soil generated during construction would be classified as geotechnically and/or chemically unsuitable for reuse on-site or hazardous, therefore requiring removal from site. Waste soils would be dealt with in accordance with the **Waste Management Strategy** presented in **Appendix 8A** of **Volume 2** of the **ES**.

11.6.24 The MMP would set out how material is managed on-site during construction and removal and reinstatement in accordance with appropriate guidance such as the Contaminated Land: Applications in Real Environments (CL:AIRE) Development Industry Code of Practice (Ref. 11.14), to allow the sustainable re-use of suitable soils during the construction and removal and reinstatement of the proposed rail extension route.

11.6.25 An **Outline SMP provided in Appendix 17C** of **Volume 2** of the **ES** would also be implemented to manage the reinstatement of agricultural land.

11.6.26 In line with the waste hierarchy the design would seek, as far as reasonably practicable, to reduce the amount of soil/materials excavated and/or of a hazardous nature, to reuse and recycle waste soils/materials on-site, where possible and to manage soils/materials suitably including off-site disposal of waste, if required, in accordance with relevant legislation. Therefore, the impacts on waste soils and soil re-use are considered to be temporary, short-term and direct.

11.6.27 Given the scale of the proposed development, the fact that the majority of the proposed rail extension route goes through agricultural land which has remained undeveloped, and that Made Ground is only likely to be associated with the existing roads crossing the proposed development, the value/sensitivity of the receptor is classed as medium. With the primary and tertiary mitigation measures, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse (**not significant**).

v. Inter-relationship effects

11.6.28 This section provides a description of the identified inter-relationship effects that are anticipated to occur on geology and land quality receptors between the individual environmental effects arising from construction of the proposed development.

11.6.29 There are anticipated to be inter-relationship effects between geology and land quality and soils and agriculture, ecology, heritage and groundwater and surface water in relation to potential receptors which could be impacted by ground contamination during the construction of the proposed development.

11.6.30 Potential impacts would include the contamination of sensitive/high value receptors such as good quality or best and most versatile (BMV) agricultural land, SSSIs, listed buildings, Principal Aquifers, Water Framework Directive rivers and groundwater SPZs during construction works. Construction activities may introduce new sources of contamination, new pathways for migration of contamination and disturb and mobilise existing sources of contamination.

11.6.31 However, given the primary and tertiary mitigation measures proposed in relation to these disciplines as outlined in **section 11.5** of this chapter, it is not expected that the combined impact of these inter-relationship effects would be greater than those effects predicted for the geology and land quality assessment as presented within this chapter. Only minor adverse inter-relationship effects are anticipated, which are classified as **not significant**. Further details are provided in **Chapter 10** and **Chapter 12** of this volume of the **ES**.

c) Operation

i. Physical effects

11.6.32 Physical effects are considered to be mainly related to the construction phase. During operation, there would be limited physical effects through maintenance operations. Suitable design and subsequent maintenance works would also minimise physical effects and the proposed development would be operated in accordance with the relevant regulations and best practicable measures.

Soil erosion

11.6.33 Soil exposure during operation of the proposed development is only likely to occur during maintenance operations through local excavations within the railway line, embankments, cuttings or associated infrastructure for maintenance. There may also be some limited exposure through failure of landscaping such as grass, shrubs and trees dying to expose the soils.

However, as maintenance operations are likely to be limited in lateral extent, time and should not, generally, entail excessive earthworks, the likelihood of substantial soil exposure and subsequent soil erosion would be low. The impacts on soil erosion during the operational phase are therefore considered to be temporary, short-term, and direct.

11.6.34 Given the above, the value/sensitivity of the receptor is classed as low. With the primary and tertiary mitigation measures the magnitude of the impact is considered to be very low. Therefore, it is considered that soil erosion would remain as negligible and classed as **not significant** for soil erosion.

Ground stability and soil compaction

11.6.35 As discussed in the construction phase, the potential for soil compaction over and above that required through the design is low. The impacts on ground stability due to the moderate UXO risk is assumed to have reduced as secondary mitigation has been implemented. The impacts on ground stability and soil compaction during the operational phase are therefore considered to be temporary, short-term, and direct.

11.6.36 Given the likely limited disturbance of the proposed development through the operational phase the value/sensitivity is classed as low. With the implementation of primary and tertiary mitigations set out in **section 11.5** of this chapter, and secondary measures associated with the construction stage set out in **section 11.7** of this chapter, the magnitude of the impact on soil compaction and ground instability is considered to be very low. The effect is therefore considered to be negligible and classed as **not significant**.

ii. Mineral resources

11.6.37 Effects in relation to mineral resources during the operation phase of the proposed development relate to the permanent sterilisation/loss of minerals, preventing future extraction. The impacts on mineral resources during the operational phase are therefore considered to be temporary, short-term, and direct. Given that there are limited valuable mineral resources located within the two study areas, the value/sensitivity of the receptor is classed as low. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources. Effects in relation to loss, damage or sterilisation of mineral resources would stay as negligible (**not significant**).

iii. Effects associated with ground contamination

11.6.38 The operational PCSM and risk assessment are presented in **Appendix 11B** of this volume and the impact assessment in **Appendix 11C** of this volume.

11.6.39 The operational impact assessment has been undertaken by comparing the baseline land contamination risks to those predicted during operation, while considering any new sources and pollution pathways introduced by operational activities.

11.6.40 The operation of the proposed development would potentially introduce new sources of contamination. Spillages and leaks may occur and below ground services could create additional potential pathways for the migration of potential contamination that were not present at baseline. The impacts on land contamination during the operational phase are considered to be permanent and direct.

Proposed rail extension route

11.6.41 A summary of the operational phase contamination effects is provided in **Table 11.17**. A more detailed assessment of operational risk and impact assessment is provided in **Appendices 11B** and **11C** of this volume. It is considered that with proposed mitigation, risks identified to human health, controlled waters, ecological and property receptors during operation are assessed as very low. Compared to the existing baseline, the level of risk to receptors has generally remained the same or decreased. An overall negligible to minor beneficial effect (**not significant**) is therefore anticipated.

Table 11.17: Operational phase effects for the proposed rail extension route.

Receptor	Sensitivity / Value	Baseline risk	Operation risk	Classification of Effect
Human (on-site)	High	Receptor not present to Low	Very low risk	Negligible to Minor beneficial **(not significant)**
Human (off-site)	High	Very low	Very low	Negligible **(not significant)**
Controlled waters: groundwater on-site and off-site)	Medium	Low	Very low	Minor beneficial **(not significant)**
Controlled waters: surface water on-site and off-site)	Low	Very low	Very low	Negligible **(not significant)**
Property: existing and future structures and services on-site and off-site)	Medium	Very Low	Very Low	Negligible **(not significant)**
Property: crops and livestock on-site and off-site)	Medium	Low	Very low	Minor beneficial **(not significant)**
Ecological (off-site)	High	Low	Very Low	Minor beneficial **(not significant)**

Proposed rail improvement works

11.6.42 A summary of the operation phase contamination effects is provided in **Table 11.18**. A more detailed assessment of operational risk and impact assessment is provided in **Appendices 11B** and **11C** of this volume. It is considered that with proposed mitigation, risks identified to human health, controlled waters and property receptors during operation are assessed as very low. Compared to the existing baseline, the level of risk to receptors has remained the same. An overall **negligible** effect (**not significant**) is therefore anticipated.

Table 11.18: Operational phase effects for the proposed rail improvement works.

Receptor	Sensitivity / Value	Baseline risk	Operation risk	Classification of Effect
Human (on-site)	High	Very low	Very low	Negligible **(not significant)**
Human (off-site)	High	Very low	Very low	Negligible **(not significant)**
Controlled waters: groundwater on-site and off-site)	Medium	Low	Low	Negligible **(not significant)**
Controlled waters: surface water on-site and off-site)	Low	Very low	Very low	Negligible **(not significant)**
Property: existing and future structures and services on-site and off-site)	Medium	Very low	Very low	Negligible **(not significant)**
Property: crops and livestock on-site and off-site)	Medium	Very low	Very low	Negligible **(not significant)**

iv. Effects associated with waste soils and soil re-use

11.6.43 The proposed development may also generate limited waste soils during operation due to maintenance requirements which may include excavations for repairs and maintenance of services. The proposed development would also be operated in accordance with the relevant regulations and best practice pollution prevention guidance. Therefore, the impacts associated with waste soils and soils reuse during the operational phase are assessed to be temporary, short-term and indirect.

11.6.44 Given that there is less potential for soil reuse during the operational phase, the value/sensitivity of the receptor is classed as low. With the primary and tertiary mitigation measures, the magnitude of the impact is considered to be very low. The overall effect is therefore assessed to be negligible (**not significant**).

v. Inter-relationship effects

11.6.45 This section provides a description of the identified inter-relationship effects that are anticipated to occur on geology and land quality receptors between the individual environmental effects arising from the operation of the proposed development.

11.6.46 There are anticipated to be inter-relationship effects between geology and land quality, soils and agriculture, ecology, heritage and groundwater and surface water in relation to potential receptors which could be impacted by ground contamination during the operation of the proposed development.

11.6.47 Potential effects would include the contamination of sensitive/high value receptors such as good quality or best and most versatile (BMV) agricultural land, SSSIs, listed buildings, Principal Aquifers, Water Framework Directive rivers and groundwater SPZs during operation. Operation of the proposed development may introduce new sources of contamination and new pathways for migration of contamination.

11.6.48 However, given the primary and tertiary mitigation measures proposed in relation to these disciplines as outlined in **section 11.5** of this chapter, it is not expected that the combined impact of these inter-relationship effects would be greater than those effects predicted for the geology and land quality assessment as presented within this chapter. Only minor adverse inter-project impacts are anticipated, which are classified as **not significant**. Further details are provided in **Chapter 10** and **Chapter 12** of this volume of the **ES**.

d) Removal and Reinstatement

11.6.49 This section sets out the assessment of geology and land quality effects associated with the removal and reinstatement of the proposed rail extension route. The proposed rail improvement works would remain as permanent.

i. Physical effects

11.6.50 As discussed in the construction assessment, the removal and reinstatement phase of the proposed rail extension route may result in physical effects including changes in soil erosion, soil compaction and ground instability issues associated with the demolition of the rail infrastructure and associated services, earthworks and movement of heavy plant for the reinstatement of the site. The impacts on soil erosion, soil compaction and ground stability are therefore considered to be temporary, short-term, and direct.

11.6.51 Given that there are limited soil erosion/compaction hazards at the site and ground stability hazards would be mitigated during the construction phase, the value/sensitivity of the receptor is classed as low. With proposed

mitigation, the magnitude of the impact is considered to be very low. The overall effects on soil erosion, soil compaction and ground stability are considered to be negligible (**not significant**).

ii. Mineral resources

11.6.52 Given that there are limited valuable mineral resources located within the study area, the value/sensitivity of the receptor is classed as low. The impacts on mineral resources during the removal and reinstatement phase are considered to be temporary, short-term, and direct. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources. Effects in relation to loss, damage or sterilisation of mineral resources during the removal and reinstatement phase would stay as negligible and are classed as **not significant**.

iii. Effects associated with ground contamination

11.6.53 The proposed rail extension route would be removed and re-instated to agricultural use. The track bed (rail, sleepers, ballast and sub-grade) and level crossings (panels, barriers, traffic signals, obstacle detection systems, etc.) would be removed and the site returned to its original topography.

11.6.54 The removal and reinstatement impact assessment is undertaken by comparing the baseline land contamination risks to those predicted during removal and reinstatement, while considering any new sources and pollution pathways which may be introduced by removal and reinstatement activities.

11.6.55 A summary of the risks identified to the identified receptors are summarised in **Table 11.19.** Further detail is provided in **Appendices 11B** and **11C** of this volume.

11.6.56 With proposed primary and tertiary mitigation incorporated into the design and effectively implemented during the removal and reinstatement phase as outlined in **section 11.5** of this chapter, risks identified to human health, controlled waters, ecological and property receptors during the removal and reinstatement phase are assessed as very low to moderate / low. Compared to the existing baseline, the level of risk to receptors has generally remained the same slightly increased. The overall effect is considered to be negligible to minor adverse effect (**not significant**).

Table 11.19: Removal and reinstatement phase effects for the proposed rail extension route.

Receptor	Sensitivity / Value	Baseline risk	Removal and Reinstatement risk	Classification of Effect
Human (on-site)	High	Low	Low	Negligible **(not significant)**
Human (off-site)	High	Very low	Low	Minor adverse **(not significant)**
Controlled waters: groundwater on-site and off-site)	Medium	Low	Moderate / low	Minor adverse **(not significant)**
Controlled waters: surface water on-site and off-site)	Low	Very low	Low	Minor adverse **(not significant)**
Property: existing and future structures and services on-site and off-site)	Medium	Very Low	Low	Minor adverse **(not significant)**
Property: crops and livestock on-site and off-site)	Medium	Low	Low	Negligible **(not significant)**
Ecological (off-site)	High	Low	Low	Negligible **(not significant)**

iv. Effects associated with waste soils and soil re-use

11.6.57 Waste soils would be generated during removal and reinstatement phase through the removal of drainage, services and infrastructure and the re-profiling of the site. There is the potential that waste soil generated during the removal and reinstatement phase is classified as geotechnically and/or chemically unsuitable for reuse on-site or as hazardous, therefore requiring removal from site. Waste soils would be dealt with in accordance with the **Waste Management Strategy** presented in **Appendix 8A** of **Volume 2** of the **ES**.

11.6.58 Soils would be managed as part of the proposed primary and tertiary mitigation for the removal and reinstatement works through an MMP to allow the re-use of suitable soils during the removal and reinstatement phase of the proposed development. Therefore, the impacts on waste soils and soil re-use are considered to be temporary, short-term and direct.

11.6.59 The value/sensitivity is classed as medium. With the primary and tertiary mitigation measures, the magnitude of the impact is considered to be low. The overall effect is therefore considered to be minor adverse (**not significant**).

v. Inter-relationship effects

11.6.60 This section provides a description of the identified inter-relationship effects that are anticipated to occur on geology and land quality receptors between the individual environmental effects arising from the removal and reinstatement of the site.

11.6.61 There are anticipated to be inter-relationship effects between geology and land quality, soils and agriculture, ecology, heritage and groundwater and surface water in relation to potential receptors which could be impacted by ground contamination during the removal and reinstatement of the proposed development.

11.6.62 Potential impacts would include the contamination of sensitive/high value receptors such as good quality or BMV agricultural land, SSSIs, listed buildings, Principal Aquifers, Water Framework Directive rivers and groundwater SPZs during removal and restatement. Removal and reinstatement activities may introduce new sources of contamination, new pathways for migration of contamination and disturb and mobilise existing sources of contamination.

11.6.63 However, given the primary and tertiary mitigation measures proposed in relation to these disciplines as outlined in **section 11.5** of this chapter, it is not expected that the combined impact of these inter-relationship effects would be greater than those effects predicted for the geology and land quality assessment as presented within this chapter. Only minor adverse inter-relationship effects are anticipated, which are classified as **not significant**. Further details are provided in **Chapter 10** and **Chapter 12** of this volume of the **ES**.

11.7 Mitigation and monitoring

a) Introduction

11.7.1 Primary and tertiary mitigation measures which have been accounted for as part of the assessment are summarised in **section 11.5** of this chapter. Where further mitigation is required this is referred to as secondary mitigation, and where reasonably practicable, secondary mitigation measures have been proposed.

11.7.2 This section describes the proposed secondary mitigation measures for geology and land quality as well as describing any monitoring required of specific receptors/resources or for the effectiveness of a mitigation measure.

b) Mitigation

11.7.3 The additional assessment of the moderate WWII UXO bomb risk identified across the proposed development would be undertaken in the form of a detailed UXO desk study and risk assessment. The assessment would identify the effective mitigation measures that are available to address the risk. Mitigation measures would then be implemented as appropriate.

11.7.4 A ground investigation would be undertaken for the proposed rail extension route to inform the detailed design of the proposed development and confirm ground conditions, contamination status and other ground related risks. This would be completed as part of the design phase prior to the commencement of construction works. Where the ground investigation and subsequent generic risk assessments identify unacceptable levels of contamination and ground related risks, further detailed quantitative risk assessment followed by, where necessary, the remediation of soil and groundwater contamination prior to construction may be required.

11.7.5 Intrusive ground investigation would also be undertaken post operation of the proposed rail extension route as part of the removal and reinstatement phase. This ground investigation would confirm the ground conditions, contamination status and other ground related risks at the site following the operational phase. Remediation of soil or ground contamination would be undertaken as part of the reinstatement if deemed necessary to ensure the site was suitable for use as agricultural land.

11.7.6 A site walkover survey would be undertaken for the proposed rail improvement works prior to construction works in order to identify areas of potential contamination risks. Surface sampling of potential areas of contamination would be undertaken to ascertain risks and any further investigatory works required.

c) Monitoring

11.7.7 A programme of short-term gas and groundwater monitoring would be designed as part of the ground investigation for the proposed rail extension route and would be required prior to construction works commencing. The results of this short-term monitoring would determine whether further long-term gas and groundwater monitoring during the construction and operational phases is required.

11.7.8 A contamination watching brief by suitably qualified and experienced personnel would be implemented for the proposed rail extension route and rail improvement works when excavating areas of potential contamination risk.

11.8 Residual effects

11.8.1 The following tables present a summary of the geology and land quality assessment. They identify the receptor(s) likely to be impacted, the level of effect and, where the effect is deemed to be significant, the tables include the mitigation proposed and the resulting residual effect.

i. Rail extension route

Table 11.20: Summary of effects for the construction phase for the rail extension route.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
Geology	Soil erosion	Health and safety risk assessments, method statements and appropriate personal protective equipment PPE for the protection of construction workers. Implementation of measures in the CoCP during construction works. Design and selection of construction materials in accordance with best practice.	Minor adverse	Detailed UXO desk study and risk assessment. Implementation of appropriate mitigation measures where required. Ground investigation and relevant risk assessments completed prior to detailed design and construction works. Remediation of soil and groundwater if necessary. Longer term gas and groundwater monitoring if necessary.	Minor adverse **(not significant)**
	Soil compaction		Negligible		Negligible **(not significant)**
	Ground instability		Moderate adverse		Minor adverse **(not significant)**
Mineral resources	Loss, damage or sterilisation		Negligible		Negligible **(not significant)**
Human	Contamination from on-site sources		Negligible to minor adverse		Negligible **(not significant)**
Controlled waters (groundwater)	Contamination from on-site sources		Minor adverse		Minor beneficial **(not significant)**
Controlled waters (surface water)	Contamination from on-site sources		Minor adverse		Negligible **(not significant)**
Property (existing and future structures and services)	Contamination from on-site sources		Minor adverse		Negligible **(not significant)**
Property (crops and livestock)	Contamination from on-site sources		Negligible		Minor beneficial **(not significant)**
Ecological	Contamination from on-site sources		Negligible		Minor beneficial **(not significant)**

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
Soils	Impacts from waste soils generated during construction works		Minor adverse		Minor adverse **(not significant)**

Table 11.21: Summary of effects for the operational phase for the rail extension route.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
Geology	Soil erosion, soil compaction and ground stability	Use of hardstanding to avoid spills and leaks. Incorporation of petrol and oil interceptors within the drainage design where considered necessary. The use of appropriate SuDS schemes. The use of grid connections for electricity where possible. Appropriate storage and disposal of fuel and wastes in accordance with current guidance	Negligible	Longer term gas and groundwater monitoring if necessary.	Negligible **(not significant)**
Mineral resources	Loss, damage or sterilisation		Negligible		Negligible **(not significant)**
Human	Contamination from on-site sources		Negligible to minor beneficial		Negligible to minor beneficial **(not significant)**
Controlled waters (groundwater)	Contamination from on-site sources		Minor beneficial		Minor beneficial **(not significant)**
Controlled waters (surface water)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (existing and future structures and services)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (crops and livestock)	Contamination from on-site sources		Minor beneficial		Minor beneficial **(not significant)**
Ecological	Contamination from on-site sources		Minor beneficial		Minor beneficial **(not significant)**
Soils	Impacts from waste soils generated		Negligible		Negligible **(not significant)**

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
	during operation				

Table 11.22: Summary of effects for the removal and reinstatement phase for the rail extension route.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
Geology	Soil erosion, soil compaction, and ground stability	Implementation of measures in the **CoCP** Health and safety risk assessments, method statements and appropriate PPE for the protection of construction workers.	Negligible	Further ground investigation and risk assessment post operation to confirm the risks at the time of removal and reinstatement and identify areas requiring further remediation. Remediation of soil and groundwater due to incident occurring during the operational phase if necessary.	Negligible **(not significant)**
Mineral resources	Loss, damage or sterilisation		Negligible		Negligible **(not significant)**
Human	Contamination from on-site sources		Negligible to minor adverse		Negligible **(not significant)**
Controlled waters (groundwater)	Contamination from on-site sources		Minor adverse		Minor beneficial **(not significant)**
Controlled waters (surface water)	Contamination from on-site sources		Minor adverse		Negligible **(not significant)**
Property (existing and future structures and services)	Contamination from on-site sources		Minor adverse		Negligible **(not significant)**
Property (crops and livestock)	Contamination from on-site sources		Negligible		Minor beneficial **(not significant)**
Ecological	Contamination from on-site sources		Negligible		Minor beneficial **(not significant)**
Soils	Impacts from waste soils generated during operation		Minor adverse		Minor adverse **(not significant)**

ii. Rail improvement works

Table 11.23: Summary of effects for the construction phase for the rail improvement works.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Secondary Mitigation	Residual Effects
Geology	Soil erosion, soil compaction and ground instability	Health and safety risk assessments, method statements and appropriate personal protective equipment PPE for the protection of construction workers. Implementation of measures in the **CoCP** during construction works. Design and selection of construction materials in accordance with best practice.	Negligible to minor adverse	Detailed UXO desk study and risk assessment. Implementation of appropriate mitigation measures where required. Site walkover survey to identify areas of potential contamination risk, surface sampling of these areas to ascertain risks. Watching brief during construction works where contamination is suspected.	Negligible to minor adverse **(not significant)**
Mineral resources	Loss, damage or sterilisation		Negligible		Negligible **(not significant)**
Human	Contamination from on-site sources		Negligible to minor adverse		Negligible **(not significant)**
Controlled waters (groundwater)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Controlled waters (surface water)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (existing and future structures and services)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (crops and livestock)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Soils	Impacts from waste soils generated during construction works		Minor adverse		Minor adverse **(not significant)**

Table 11.24: Summary of effects for the operational phase for the rail improvement works.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Mitigation	Residual Effects
Geology	Soil erosion, soil compaction	Use of hardstanding	Negligible	None required	Negligible **(not significant)**

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of effects	Additional Mitigation	Residual Effects
	and ground instability	to avoid spills and leaks. Incorporation of petrol and oil interceptors within the drainage design where considered necessary. The use of appropriate SuDs schemes. The use of grid connections for electricity where possible. Appropriate storage and disposal of fuel and wastes in accordance with current guidance.			
Mineral resources	Loss, damage or sterilisation		Negligible		Negligible **(not significant)**
Human	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Controlled waters (groundwater)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Controlled waters (surface water)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (existing and future structures and services)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Property (crops and livestock)	Contamination from on-site sources		Negligible		Negligible **(not significant)**
Soils	Impacts from waste soils generated during operation		Negligible		Negligible **(not significant)**

References

11.1 Department for Communities and Local Government. Environmental Impact Assessment: A Guide to Good Practice and Procedures. A Consultation Paper (DCLG). 2006.

11.2 European Commission. Water Framework Directive 2000/60/EC. October 2000.

11.3 European Commission. Waste Framework Directive 2008/98/EC. 2008.

11.4 United Kingdom Parliament. Environmental Protection Act. 1990.

11.5 United Kingdom Parliament. Water Resources Act. 1991.

11.6 Health and Safety Executive. Control of Substances Hazardous to Health Regulations. 2002.

11.7 Health and Safety Executive. The Construction (Design and Management) Regulations. 2015.

11.8 UK Government, “Waste Management Regulations (SI 2016/24),” 2016.

11.9 UK Government, “The Landfill (England and Wales) Regulations (SI 2002/1559),” 2002.

11.10 United Kingdom Parliament, “The Hazardous Waste (England and Wales) Regulations (SI 2005/894),” 2005 (as amended).

11.11 United Kingdom Parliament, “The Environmental Permitting (England and Wales) Regulations (SI 2010/675),” 2016 (as amended).

11.12 Department of Energy and Climate Change. Overarching National Policy Statement for Energy (EN-1). London: The Stationery Office. 2011.

11.13 Department of Energy and Climate Change. National Policy Statement for Nuclear Power Generation (EN-6). London: The Stationery Office. 2011.NHBC and Environment Agency, R&D Publication 66 - Guidance for the Safe Development of Housing on Land Affected by Contamination, 2008.

11.14 MHCLG (2019) National Planning Policy Framework https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed July 2019].

11.15 MHCLG (2019) Planning Practice Guidance https://www.gov.uk/government/collections/planning-practice-guidance [Accessed July 2019].

11.16 DEFRA (2018) Government's 25 Year Environment Plan. https://www.gov.uk/government/publications/25-year-environment-plan [Accessed July 2019].

11.17 ESC (2013) Suffolk Coastal District Council Core Strategy and Development Management Policies. https://www.eastsuffolk.gov.uk/planning/local-plans/suffolk-coastal-local-plan/existing-local-plan/core-strategy-and-development-management-policies/ [Accessed July 2019].

11.18 ESC (2019) Suffolk Coastal District Council Final Draft Local Plan https://www.eastsuffolk.gov.uk/planning/local-plans/suffolk-coastal-local-plan/local-plan-review/final-draft-local-plan/ [Accessed July 2019].

11.19 Department for Environment, Food and Rural Affairs. Environmental Protection Act: Part 2A Contaminated land Statutory Guidance. 2012.

11.20 Department for Environment, Food and Rural Affairs and Environment Agency. Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination. 2012.

11.21 Environment Agency. GPLC1 – Guiding Principles for Land Contamination. March 2010.

11.22 CL:AIRE. The Definition of Waste: Development Industry Code of Practice. March 2011.

11.23 Highways England, "Design Manual for Roads and Bridges. Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects," August 2008.

11.24 Highways England, "DMRB Volume 11, Section 3, Part 11 Geology and Soils," June 1993.

11.25 Environment Agency, "Department of the Environment (DoE) – Industry Profiles for previously developed land," 1995.

11.26 Construction Industry Research and Information Association, "C552 – Contaminated Land Risk Assessment – A Guide to Good Practice," 2001.

11.27 NHBC and Environment Agency, R&D Publication 66 - Guidance for the Safe Development of Housing on Land Affected by Contamination, 2008.

11.28 CIRIA, "C665 – Assessing Risks Posed by Hazardous Ground Gases to Buildings," 2007.

11.29 British Standards, "BS 8485 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings," 2015.

11.30 CIRIA, "C681 – Unexploded Ordnance – A Guide for the Construction Industry," 2009.

11.31 CIRIA, "C733 - Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks," 2014.

11.32 CIRIA, "C682 – The Volatile Organic Contaminants Handbook," 2009.

11.33 British Standards, "BS 5930 – Code of practice for ground investigations," 2015.

11.34 British Standards, "BS10175:2011+A2:2017 – Code of Practice for Investigation of Potentially Contaminated Sites," 2013.

11.35 British Geological Society. GeoIndex – Map Index to British Geological Survey (BGS) data website. 2016 (Online) Available from: http://www.bgs.ac.uk/GeoIndex/ [Accessed August 2019].

11.36 Suffolk County Council. Suffolk Minerals Local Plan. (Online). Available from: http://www.suffolk.gov.uk/environment-and-transport/planning-and-buildings/Minerals-and-Waste-Planning/suffolk-minerals-local-plan/ [Accessed July 2019].

11.37 Suffolk Biodiversity Information Service. (Online). Available from: https://www.suffolkbis.org.uk/suffolk-sites [Accessed July 2019].

11.38 Department for Environment, Food and Rural Affairs. Multi-Agency Geographic Information for the Countryside (MAGIC) website. (Online) Available from: http://magic.defra.gov.uk/Login.aspx?ReturnUrl=%2fMagicMap.aspx http://magic.defra.gov.uk/Login.aspx?ReturnUrl=%2fMagicMap.aspx [Accessed July 2019].

11.39 Zetica. Unexploded Bomb Risk Maps. (Online). Available from: http://www.zetica.com/uxb_downloads.htm [Accessed July 2019].

11.40 Energy., EDF. Aldhurst Farm - Habitat Creation Scheme Planning Application - Land Contamination Assessment (December 2014).

11.41 Structural Soils Ltd, "Factual Report on Ground Investigation on Sizewell C Construction Site Area and Associated Development. SZC-NNBPCP-XX-000-REP-000014," November 2014.

11.42 Network Rail Standard, Track Maintenance, renewal or alteration – Used ballast handling, NR/L3/ENV/044, June 2018.

11.43 Network Rail Standard, Environmental and Social Minimum Requirements for Projects – Design and construction, NR/L2/ENV/015, March 2019.