Norwich Western Link Environmental Statement Chapter 13: Geology and Soils

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Glossary of Abbreviations and Defined Terms

The definition of key terms used in this report are provided below. These definitions have been developed by reference to the definitions used in EU and UK legislation and guidance relevant to Geology and Soils as well as professional judgement based on knowledge and experience of similar schemes in the context of the Proposed Scheme.

Term	Definition
Agricultural Land Classification (ALC)	A framework for determining the physical quality of the land at national, regional and local levels. This is based on the long term physical limitations of land for agricultural use. There are a number of factors that affect the grade and the main ones are climate, site and soil characteristics, and the interactions between them.
Best and Most Versatile Agricultural Land (BMV)	Defined as Grades 1, 2 and 3a in the Agricultural Land Classification by the revised National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG). This is the land which is determined to be most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals. Grades 3b, 4, and 5 are used to classify land that is of moderate quality to very poor quality.
British Geological Survey (BGS)	Provider of objective and authoritative geoscientific data, information and knowledge for the UK.
Contaminated Land	sSignificant possibility to cause significant harm to people, property or protected species; or, where significant pollution is being caused or has a significant possibility of being caused to controlled waters.

Term	Definition
Controlled Waters	As defined in section 104 of under the Water Resources Act 1991. The term controlled waters refers to territorial waters, coastal waters, inland freshwaters and ground waters. :
Environmental Receptor	Environmental receptor is specifically defined as: features of the environment that are subject to assessment under Article 3 of the EIA Directive, namely population and human health, biodiversity, land, soil, water, air and climate, material assets, cultural heritage and landscape.
Exceedance	Where the concentrations of a pollutant is greater than the appropriate and relevant quality standard.
Ground Investigations	The physical survey of ground conditions. Comprised of targeted investigations including both intrusive and non-intrusive techniques to prove ground conditions, determine soil / rock / groundwater parameters and identify hazards associated with the ground conditions to inform a Proposed Development.
Hazard	Anything with the potential to cause harm, including ill-health and injury, damage to property or the environment; or a combination of these.
Hydrology	The movement, distribution and quality of water throughout the earth.
Made Ground	Areas where material is known to have been placed by people on the pre-existing (natural or artificial) land surface (including engineered fill).

Term	Definition
Nitrate Vulnerable Zone (NVZ)	This dataset sets out the NVZ designations following the 4 yearly review for implementation in 2017. These are the final designations following appeals. NVZs are areas designated as being at risk from agricultural nitrate pollution. This dataset sets out the NVZ designations following the 4 yearly review for implementation in 2017. These are the final designations following appeals. The designations are made in accordance with the Nitrate Pollution Prevention Regulations 2015. Waters are defined within the Nitrates Direction as polluted if they contain or could contain, if preventative action is not taken, nitrate concentrations greater than 50mg/L.
Principal Aquifer	These 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 aquifers.
Risk	The likelihood of an impact occurring combined with effect or consequence(s) of the impact on a receptor if it does occur.

Term	Definition
Secondary Aquifer	These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary Aaquifers are subdivided into two types: Secondary A - 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; and Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. The term 'Secondary Undifferentiated' is also used in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Site-won Material	Soils and other materials generated from within the Site Boundary as a result of the construction of the Proposed Scheme.

Term	Definition
Source Protection Zone (SPZ)	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 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.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
Waterbody	A discrete body of water forming a physical feature.

Term	Definition
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
BGS	British Geological Survey
BMV	Best and Most Versatile Agricultural Land
BS	British Standard
CDM	Construction Design and Management
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
COMAH	Control of Major Accident Hazards
CSM	Conceptual Site Model
DEFRA	Department for Environment Food & Rural Affairs

Term	Definition
DMRB	Design Manual for Roads and Bridges
DoW	Definition of Waste
EA	Environment Agency
EHO	Environmental Health Officer
EPA	Environmental Protection Act
GQRA	Generic Quantitative Risk Assessment
GWDTE	Groundwater dependent terrestrial ecosystem
HSE	Health and Safety Executive
H&S	Health and Safety
IEMA	Institute of Environmental Management and Assessment
LCRM	Land Contamination Risk Management
LNR	Local Nature Reserve
m	Metres
mAOD	Metres above ordnance datum
MAGIC	Multi-Agency Geographic Information for the Countryside
mbgl	Metres below ground level
MMP	Materials Management Plan
mg/l	Milligrams per litre
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
PPE	Personal Protective Equipment
PRA	Preliminary Risk Assessment
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems

Term	Definition
WFD	Water Framework Directive
µg/m3	Microgram (µg) per cubic metre

13 Geology and Soils

13.1 Introduction

13.1.1 This chapter reports the outcome of the assessment of likely significant effects arising from the Proposed Scheme upon Geology and Soils. The chapter describes the methodology used and the baseline conditions relevant to the assessment, both of which have been used to reach the conclusions presented.

13.1.2 A summary of any adverse environmental effects has been provided, and mitigation measures required to avoid, prevent, reduce or offset effects found to be significant, have been set out. The expected residual effects and any required monitoring after mitigation measures have been employed, are also presented. Opportunities for environmental enhancement, where such opportunities exist, have been discussed in this chapter.

13.1.3 This chapter is intended to be read as part of the wider ES, with particular reference to **Chapter 10: Biodiversity** (Document Reference 3.10.00), **Chapter 12: Road Drainage and the Water Environment** (Document Reference 3.12.00), **Chapter 14: Material Assets and Waste** (Document Reference 3.14.00), **Chapter 15: Climate Greenhouse Gases** (Document Reference 3.15.00) and **Chapter 17: Population and Human Health** (Document Reference 3.17.00).

13.1.4 This chapter sets out the assessment of the potential effects from chemical contamination on Controlled Waters. Potential effects relating to physical contamination (i.e., sediment) and changes to groundwater recharge and flow are considered within **Table 12.22** in **Chapter 12: Road Drainage and the Water Environment** (Document Reference 3.12.00).

13.1.5 A number of appendices and figures have been produced to accompany this Chapter including:

- **Appendix 13.1**: NCCT41793-04-B-06-02 20200615, Interpretative Environmental Desk Study Report, Norwich Western Link, WSP UK Ltd, dated July 2023 (Document Reference 3.13.01)
- **Appendix 13.2**: 70041922-GS-001, Generic Quantitative Risk Assessment, Norwich Western Link, WSP UK Ltd, dated October 2021 (Document Reference 3.13.02)
- **Appendix 13.3**: NCCT41793-RAM-EGT-FSC-RP-NZ-0003-P03, Ground Contamination Interpretive Report, Norwich Western Link, Ramboll UK Limited, dated April 2023 (Document Reference 3.13.03)
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13.2 Legislative Framework, Policy and Guidance

Legislative Framework

13.2.1 The applicable legislative framework is summarised as follows:

National

Environmental Protection Act (1990) Part 2A, Section 78A (Ref 13.1)

Part 2A of the *Environmental Protection Act (EPA) 1990 (as amended)* deals with contaminated land which is defined as:

"any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substance in, on or under the land that;

a) Significant harm is being caused or there is significant possibility of such harm being caused; or

b) Significant pollution to controlled waters is being caused, or there is a significant possibility of such pollution being caused".

The Contaminated Land (England) (Amendment) Regulations 2012 (Ref 13.2)

13.2.2 The Regulations provide a definition of what constitutes 'contaminated land' and set out the responsibilities of the local authority and the Environment Agency (EA) in the identification and management of contaminated land. Government objectives with respect to land contamination policy and the Part 2A regime of the EPA 1990 are set out in the Department for Environment Food and Rural Affairs (Defra) Contaminated Land Statutory Guidance 2012 (**Ref 13.3**) as:

- "Identify and remove unacceptable risks to human health and the environment;
- Seek to ensure that contaminated land is made suitable for its current use; and

- Ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development."

13.2.3 These three objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements:

- Ensuring that land is suitable for its current use;
- Ensuring that land is made suitable for any new use; and
- Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land.

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (Ref 13.4)

13.2.4 The overall objective of the Water Framework Directive (WFD) is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are as follows:

- Ensure, where feasible, that all surface water and groundwater bodies reach 'good' status (in terms of ecological and chemical quality and water quantity, as appropriate);
- Proposed projects do not compromise measures identified to reach improved / good status;
- Prevent water body deterioration, promote sustainable water use, reduce pollution and contribute to the mitigation of flood and droughts.

Groundwater Directive (2006/118/EC) (Ref 13.5)

13.2.5 The Groundwater Directive aims to set groundwater quality standards and introduce measures to prevent or limit pollution of groundwater, including those listed with the 'List of Priority Substances'. The Directive has been developed in response to the requirements of Article 17 of the WFD, specifically the assessment of chemical status of groundwater and objectives to achieve 'good' status.

Construction (Design and Management) (CDM) Regulations 2015 (Ref 13.6)

13.2.6 This requires clients (those persons who are instructing contractors) to use their influence to ensure that the arrangements made by other duty holders are sufficient to safeguard the health and safety of those working or those affected by that work.

Environment Act, 2021 (Ref 13.7)

13.2.7 The Environment Act 2021 provides a framework for improving environmental management across a wide spectrum of issues including water quality, nature and biodiversity. It aims to deliver long-term targets to improve environmental conditions and reduce pollution.

Dangerous Substances Directive 2006/11/EC (Ref 13.8)

13.2.8 The Directive focuses on pollution caused by certain substances discharged into the water environment and aims to reduce pollution of surface waters by these dangerous substances, which have been selected mainly on the basis of how toxic or persistent they are, including how much they may accumulate in organisms.

Control of Asbestos Regulations 2012 (Ref 13.9)

13.2.9 The Control of Asbestos Regulations provide a framework for the management of asbestos / asbestos containing materials (ACMs) in existing non-domestic premises and during any work activity involving asbestos. Duty holders must make sure anyone who carries out any work

in non-domestic premises and any occupants of the premises are not exposed to asbestos from ACMs that may be present.

Contaminated Land (England) Regulations 2006 (Ref 13.10)

13.2.10 These Regulations make provision for the identification and remediation of contaminated land under Part 2A of the EPA 1990. The Regulations make provision for an additional description of contaminated land that is required to be designated as a special site.

***Environmental Damage (Prevention and Remediation) Regulations 2015* (Ref 13.11)**

13.2.11 These Regulations oblige those who create environmental damage, whether by water pollution, adversely affecting protected species or sites of special scientific interest (SSSIs), or by land pollution that causes risks to human health, to not only cease the damage, but also to implement a wide variety of remedial measures to restore affected areas.

Water Resources Act (England and Wales) 1991 (Ref 13.12)

13.2.12 Section 104 of the Water Resources Act 1991 provides a definition of Controlled Waters which includes territorial waters within the 3 nautical mile limit, coastal waters extending inland, inland waters and groundwater any waters contained in underground strata.

Town and Country Planning (Development Management Procedure) (England) Order 2015 (Ref 13.13)

13.2.13 Planning authorities must consult Natural England on all non-agricultural applications that result in the loss of more than 20 hectares (ha) of best and most versatile land if the land is not included in a development plan. For example, this includes the likely cumulative loss of best and most versatile land from a proposed development if it is part of a phased development.

13.3 Policy

13.3.1 The applicable policy framework is summarised as follows:

National Policy Statement for National Networks (Ref 13.14)

13.3.2 Chapter 5 of the National Networks National Policy Statement (NN NPS) sets out the provisions to support Government decision making for Nationally Significant Infrastructure Projects (NSIPs), subject to the requirement to obtain a development consent under the Planning Act 2008. Although the Proposed Scheme is not an NSIP, the NPS may still be considered to be relevant. A revised draft NN NPS was published in March 2023. No material change in the approach to ground conditions and pollution are included within the draft NN NPS. However it provides an update of the policy on agricultural soils.

13.3.3 Relevant policies in relation to ground conditions, agricultural land and pollution are as follows. Relevant paragraphs within the draft NN NPS are also provided:

Para 5.168 of the extant NN NPS states that:

'Applicants should take into account the economic and other benefits of the best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification). Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality. Applicants should also identify any effects, and seek to minimise impacts, on soil quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites provided that it is not of high environmental value. For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination and how it is proposed to address this.'

In addition to the above para 5.180 from the draft NN NPS also states that:

'Applicants should also identify any effects, and seek to minimise impacts, on soil health and protect and improve soils, taking into account any mitigation measures proposed. Soil is an important natural capital resource, providing many essential services such as storing carbon (also known as a carbon sink), reducing the risk of flooding, providing wildlife habitats and delivering global food supplies. Guidance on sustainable soil management can be found in Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. As a first principle, developments should be on previously developed (brownfield) sites provided that it is not of high environmental value.'

Para 5.181 in Draft NN NPS states that:

'The Agricultural Land Classification is the only approved system for grading agricultural quality in England and Wales. If necessary, field surveys should be used to establish the Agricultural Land Classification grades in accordance with the current grading criteria, or any successor to it and identify the soil types to inform soil management at the construction, operation and decommissioning phases in line with the Defra Construction Code. Applicants are encouraged to develop and implement a Soil Resources and Management Plan which could help to use and manage soils sustainably and minimise adverse impacts on soil health and potential land contamination. This is to be in line with the ambition set out in the 25 Year Environment Plan to manage all of England's soils sustainably by 2030.'

Para 5.176 of the extant NN NPS states that (there is no equivalent paragraph included within draft NN NPS):

'The decision-maker should take into account the economic and other benefits of the best and most versatile agricultural land. The decision maker should give little weight to the loss of agricultural land in grades 3b, 4 and 5, except in areas (such as uplands) where particular agricultural practices

may themselves contribute to the quality and character of the environment or the local economy.'

Para 5.219 and 5.220 states that (para 5.243 and 5.244 in draft NN NPS):

'Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction and operation, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats … and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive.

'The Government's planning policies make clear that the planning system should contribute to and enhance the natural and local environment by, amongst other things, preventing both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution. The Government has issued guidance on water supply, wastewater and water quality considerations in the planning system. Where applicable, an application for a development consent order has to contain a plan with accompanying information identifying water bodies in a River Basin Management Plan.'

National Planning Policy Framework

13.3.4 Chapter 15 of the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2021) (last updated 20 December 2023) (**Ref 13.15**) sets out the provisions for planning decisions in relation to ground conditions and pollution issues as follows:

Paragraph 180 states that:

"Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan)

b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland.

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

Paragraph 189 states that:

"Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities

such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation)

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.";

Paragraph 190 states that:

"Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rest with the developer and/or landowner."

Paragraph 191 states that

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development."

13.3.5 In addition, under Chapter 11 "Making effective use of land", paragraph 124 states "Planning policies and decisions should:… c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated and unstable land".

A Green Future: Our 25 Year Plan to improve the Environment (Ref 13.16)

13.3.6 This sets out the Government's 25-year plan to improve the health of the environment by using natural resources more sustainably and efficiently. It plans to: protect the best agricultural land; put a value on soils as part of

our natural capital; manage soils in a sustainable way by 2030; and restore and protect peatland.

Local Policies

- Broadland District Council (BDC) Development Management DPD (August, 2015) (Ref 13.17),
- Policy EN4 – Pollution:

  "Development proposals will be expected to include an assessment of the extent of potential pollution. Where pollution may be an issue, adequate mitigation measures will be required. Development will only be permitted where there will be no significant adverse impact upon amenity, human health or the natural environment."

- Norfolk County Council's Environmental Policy (November, 2019) **(Ref 13.18)**
- Using and managing land sustainably

  "Improving soil health"

- Greater Norwich Development Partnership Joint Core Strategy for Broadland, Norwich and South Norfolk (published March 2011, amended January 2014) **(Ref 13.19)**
- Policy 1: Addressing climate change and protecting environmental assets

  "minimise water use and protect groundwater sources."

  "protect mineral and other natural resources identified through the Norfolk Minerals and Waste Development Framework."

- Policy 2: Promoting good design

  "the need to design development to avoid harmful impacts on key environmental assets and, in particular SACs, SPAs and Ramsar sites."

- Broadland District Council and South Norfolk District Council Contaminated Land Strategy (2019 – 2024) **(Ref 13.20)**

Guidance

13.3.7 The following guidance documents have been used during the preparation of this chapter:

- Planning Practice Guidance, Land Affected by Contamination, July 2019 (**Ref 13.21**)
- Highways Agency, (2019) Design Manual for Roads and Bridges (DMRB) Sustainability and Environmental Appraisal LA 104 Environmental Assessment and Monitoring (**Ref 13.21**)
- DMRB, (October 2019) LA 109 Geology and Soils (**Ref 13.22**);
- DMRB, (March 2020) LA 113 Road Drainage and the Water Environment (**Ref 13.23**);
- IEMA, (February 2022) A New Perspective on Land and Soil in Environmental Impact Assessment (**Ref 13.24**);
- Ministry of Housing, Communities & Local Government, (March 2014) Planning Practice Guidance Minerals (**Ref 13.25**);
- Ministry of Housing, Communities & Local Government, (July 2019), Planning Practice Guidance Land affected by contamination (**Ref 13.26**);
- Department for Environment, Food and Rural Affairs, (2012), Contaminated Land Statutory Guidance (**Ref 13.27**);
- EA, (2020), Land Contamination Risk Management (LCRM) (**Ref 13.28**);
- Contaminated Land: Applications in Real Environments (CL:AIRE), (2011), The Definition of Waste: Development Industry Code of Practice (DoW: CoP) (**Ref 13.29**);

- British Standards (BS) 10175 (2011+A2:2017), Investigation of Potentially Contaminated Sites - Code of Practice (**Ref 13.30**);
- CIRIA (2001) C552: Contaminated Land Risk Assessment: A guide to good practice(**Ref 13.31**);
- Society of Brownfield Risk Assessment, Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change(**Ref 13.32**).

13.4 Consultation, Scope, Methodology and Significance Criteria

13.4.1 The Proposed Scheme has the potential to affect Geology and Soils as a result of:

During construction:

- Construction of approximately a 6 km long dual-carriageway road including intersections;
- Construction of a viaduct crossing the River Wensum Special Area of Conservation and floodplain (approximately 490m in length and approximately 6-13m from ground level to the underside of the deck). The ten-span bridge design includes piled piers within the floodplain and a maintenance track which will cross a floodplain ditch via a culvert within the floodplain;
- Culvert structure for a tributary of the River Tud and enhancement works (such as bank reprofiling);
- Construction of sloped earth embankments and cuttings to manage the topography, earth bunds, landscape planting, drainage basins, and maintenance access tracks. The Proposed Scheme's earthworks will look to achieve an on-site cut and fill balance as far as practicable;
- Development of landscaping and environmental mitigation, Environmental Enhancement and Essential Mitigation Areas and Water Framework Directive mitigation;

- Establishment of temporary construction compounds, site preparation and levelling; and,
- Enabling works including the preparation of the laydown areas, car parks, haul roads and site establishment.

During operation:

- No operational activities as part of the Proposed Scheme are considered to potentially impact on Geology and Soils. Operation and maintenance of the Proposed Scheme would be aligned with the regulatory responsibilities of Norfolk County Council in its capacity as the local highway authority.

Consultation Undertaken to Date

13.4.2 A Scoping Opinion was sought on two occasions, in June 2020 (for which a Scoping Opinion was received 16 October 2020) and a Scoping Addendum which was submitted in July 2022 to take account of a localised alignment refinement. A response was received on the 27 September 2022. All Scoping Reports and Opinions are appended to **Chapter 5: Approach to EIA** (Document Reference 3.05.00).

13.4.3 **Table 13-1** accounts for any regulatory consultation undertaken in support of the preparation of this assessment and outlines where this is addressed in the chapter.

Table 13-1 Summary of consultation undertaken

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Environment Agency (EA)	Sustainable Places – Planning Specialist	Scoping opinion (Addendum) (Ref: SCO/2022/0001), received 27th September 2022	*'There is a safeguarded waste management facility (former Attlebridge Landfill) close to the Site Boundary for the Proposed Development, which has a 250m consultation zone around it that intersects part of the northern Site Boundary for the Proposed Development. As a result, there is the potential for indirect impacts to the aftercare of the former waste facility that need to be assessed.* *It is not clear whether Attlebridge landfill site has been assessed as part of the EID. The proposed roundabout off the Fakenham Road and road to the River Wensum would pass over land to the south of the Attlebridge landfill site. This site, which is now closed for new waste, has taken waste into lined cells for many years, but previously operated on a dilute and disperse premise.* *Additional water quality monitoring may be needed to ensure that any groundwater in the construction area that needs to be discharged is free from contamination.'* An assessment of the potential impact to the former Attlebridge Landfill is provided in Table 13-20. A ground investigation has been undertaken along the Proposed Scheme and includes groundwater sampling and testing of the area within the consultation zone. A summary is provided in Section 13.5 and the full report provided as **Appendix 13.3** (Document Reference 3.13.03). *'We note that Tables 9-2 & 9-3 provide summaries of potential on and off-site sources of contamination.'* '*It is not clear whether paragraphs 11.3.5 and 11.3.7 of the Original Scoping Report are referring to licensed abstractions or all abstractions? This needs to clearly set out in the ES.*' This is provided within Section 13.5.10.

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Environment Agency (EA)	Sustainable Places – Planning Specialist	Scoping opinion (Ref: AE/2020/125293/01-L01), received 24th July 2020	Unlicensed water abstractions may be present within the study area. As such, these should be scoped into the assessment. Any mitigation measures recommended should include validation and monitoring (if required). CLR11 guidance has been superseded by Land Contamination Risk Management (LCRM) Guidance. LCRM guidance has been used within this assessment as outlined in Section 13.2 and 13.5.
Norfolk County Council (NCC)	Principal Planner (Minerals and Waste Policy)	Scoping opinion (ref: SCO/2020/0001), received 15th July 2020	NCC identified a safeguarded waste management facility (former Attlebridge Landfill) and associated 250m consultation area which intersects a small part of the northern Site Boundary of the Proposed Scheme. NCC noted that construction works in this area may indirectly impact the aftercare of the former waste facility. NCC have flagged that any future planning applications need to address the Norfolk Minerals and Waste Core Strategy policy (CS16) which applies to the safeguarding of both minerals and waste. Mineral resources are outlined within the baseline in paragraph 13.5.20 to 24. Assessment of minerals and waste are included within **Chapter 14: Material Assets and Waste** (Document Reference 3.14.00).
Natural England (NE)	NE Soils Specialist and Peat Specialist	DAS Advice by virtual meeting 7th December 2023	Follow-up meeting to address NE queries following the meeting on 25th October 2023, as outlined in the email of 10th November 2023. These queries related to the hydrological and hydrogeological impact of the proposed construction works of the viaduct on the soils within the floodplain and are detailed in **Chapter 12: Road Drainage and the Water Environment** (Document Reference 3.12.00). An assessment of the impact to the hydrological function of soils is contained within **Table 13-25**.

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Natural England (NE)	Senior Adviser, Sustainable Development, Norfolk & Suffolk	DAS Response by email 10th November 2023	*'We are currently concerned about the impacts on the soils and their natural capital/ecosystem services. Features of the soil which could be damaged by the proposals include: its influence on the hydrological function of the floodplain and therefore the special features for which the River Wensum SAC and the River Wensum SSSI were designated; carbon storage; agricultural use; water filtration; flood management; and support for wildlife and their habitats.* *To further explain in relation to both the statutory, and non-statutory designated sites, we have identified the following impact pathways which need to be assessed:* • *Removal and replacement of the existing peaty soils with a different material could change both the hydrological functioning of the floodplain and the vegetation within it. This would then alter groundwater flows, water levels, river flows and lag times as well as the river water chemistry. These changes would alter the river and floodplain ecology, affecting both the river itself as a designated interest feature and the other species interest features of the site.* • *Alongside the permanent changes of replacing the soils, the introduction of a culvert, sheet piling, and any dewatering could again interfere with the hydrology, having a similar effect to the above. Further information on each of these activities is required.* • *The proposed works could lead to mobilisation of soil, sediment, nutrients, or pollutants entering the river or groundwater that supports the river. As well as surface water flows across the floodplain this can happen via interflow within the soil, superficial or bedrock layers. This would result in diffuse water pollution, affecting water quality.'* An assessment of the hydrological and hydrogeological impacts on the floodplain in relation to the removal of soils is contained within **Chapter 12: Road Drainage and the Water Environment** (Document Reference 3.12.00). An assessment of the impact to the carbon storage, water quality and ecological function of soils is contained within **Table 13-25**. An assessment of agricultural soils is contained within **Table 13-24**.

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Natural England (NE)	NE Soils Specialist and Peat Specialist	DAS Advice by virtual meeting 25th October 2023	A presentation of the section of the Proposed Scheme over the River Wensum floodplain and proposed temporary works platform for the viaduct was provided to NE. The worse case scenario of the excavation of peaty soils for off-site disposal as part of the construction of the viaduct was presented as is assessed within this chapter. Reuse proposals for other soils across other areas of the Proposed Scheme were presented. A response to this presentation was provided by NE on 10th November, described above.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 26th April 2023	Email returning voicemail from NE's Lead Advisor. Consultation meeting requested.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 27th March 2023	Email requesting consultation meeting.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 23rd March 2023	Email returning voicemail from NE's Lead Advisor. Available reports on soils (Document Reference 3.13.04, 3.13.05 and 3.13.06) provided to NE for information and request for consultation on potential impacts to the River Wensum floodplain following the temporary works options appraisal. No response received.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 16th March 2023	Email returning voicemail from NE's Lead Advisor. Request submitted for NE's to arrange a meeting to discuss the ALC and peat survey's and potential impact on the River Wensum Floodplain.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 12th December 2022	Request submitted for NE's Discretionary Advice Service (DAS) to discuss the ALC and peat surveys. No response received.
Natural England (NE)	Lead Adviser – Norfolk & Suffolk Team	Pre-App request by email 8th November 2022	Request submitted for NE's Discretionary Advice Service (DAS) to discuss the ALC and peat surveys. No response received.

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Natural England (NE)	Customer services team	Scoping opinion (ref: 327970), received 12th October 2020	NE highlighted a number National Planning Policy Framework requirements such as the following: Impacts from development should be considered in-light of government policy for the protection of the best and most versatile (BMV) agricultural land. Soils should be considered in the context of sustainable use of land and the ecosystems they provide as a natural resource. Sites for peat extraction should not be proposed in the development as they should not be granted permission. Baseline information on soil in relation to source and soil function is outlined in Section 13.3 and impacts to agricultural soils and soil function are assessed in Section 13.6.
North Norfolk District Council (NNDC) and Broadland District Council (BDC)	Environmental Management Officer	Request for information from NNDC Contaminated Land Officer; 13/05/2020	Six areas of possible filled ground concentrated around the A47 were identified to fall within close proximity to the southern extents of the Proposed Scheme. One of which is located within the Site Boundary. NNDC and BDC indicated that it is likely that domestic heating oil tanks are present at properties within the area. NNDC and BDC have no knowledge of any past industrial/commercial uses on or close to the Proposed Scheme other than agriculture. NNDC and BDC have not declared any sites as contaminated within the Site Boundary. The Attlebridge landfill site is located within 500m of the Site Boundary (located at NGR 614722 315986). NNDC and BDC are not aware of any soil or groundwater remediation works within the study area.

Organisation	Individual	Form of consultation	Summary of outcome of discussions
Environment Agency (EA).	Customers & Engagement Officer	Request for environmentally pertinent information from NCC Contaminated Land Officer; 06/11/2019	The EA confirmed that there are no existing water quality monitoring points within 1 kilometre of the Proposed Scheme. The EA confirmed that they are not aware of the presence of any above ground storage tanks or any spills/leaks associated the presence of these. The EA suggested that the Proposed Scheme does not cross any sites covered by environmental permits or waste management licensing. However, the EA noted that the Attlebridge landfill was located within close proximity to the Site. They noted that the Site had ceased accepting waste and that they do not envisage any issues. The EA were unaware of any remedial works carried out within the study area.

Scope of Assessment

13.4.4 The scope of this assessment has been established through the EIA scoping process. Further information can be found in **Chapter 5: Approach to EIA** (Document Reference 3.05.00).

13.4.5 This section provides an update to the scope of the assessment and re-iterates the evidence base for scoping out elements following further iterative assessment.

13.4.6 Since the Scoping Report 2020 was submitted, the EA's guidance CLR11 (2004) (**Ref 13.33**) has been withdrawn and replaced with land contamination risk management (LCRM) guidance (**Ref 13.29**). However, LCRM maintains the same approach and assessment methodology as CLR11. Therefore, despite the change of guidance, the approach within the June 2020 Scoping Report remains valid.

13.4.7 LCRM guidance advocates the use of a conceptual risk assessment model (Conceptual Site Model). The basis of this approach comprises three elements: a source, a pathway and a receptor.

13.4.8 The potential effect of the Proposed Scheme on ground conditions, and/or the effect of ground conditions on the Proposed Scheme, has been assessed during the construction stage only. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Scheme and the importance or sensitivity of the affected receptor or receiving environment to change.

Elements Scoped out of the Assessment

13.4.9 The following elements are not considered to give rise to likely significant effects as a result of the Proposed Scheme and have therefore not been considered in more detail within this assessment. This is reflective of the June 2020 and July 2022 scoping report approaches and informed by the Scoping Opinions received in October 2020 and September 2022.

Operational Stage

13.4.10 It is anticipated that any contamination identified during the construction stage will be remediated in-line with national and local planning policy upon consideration of the proposed end use. This is referred to in more detail in this chapter. Any imported material, if required, will be validated for chemical quality and suitability for placement at the required depth prior to use. This negates the requirement for consideration of potential impacts to future users of the Proposed Scheme, third-party neighbours, flora and fauna, infrastructure (inclusive of potable water supply) and Controlled Waters receptors during the operational stage. Therefore, the potential exposure of the aforementioned receptors during the operational stage will not be significant and has been excluded from this assessment.

13.4.11 Given the nature of the Proposed Scheme it is assumed that there are no plausible pathways (i.e., enclosed or confined spaces/structures) by which ground gases and vapours (including radon) could accumulate and pose an impact to human health (inhalation of asphyxiant) or infrastructural receptors (explosive risk). Therefore, the potential for the presence of ground gases and vapours to pose impacts on the identified receptors during the operational stage has been discounted from further assessment.

13.4.12 Once the Proposed Scheme is operational, activities will not require the use of agricultural land (or other soils) and are unlikely to affect soil quality causing degradation of BMV land or soil function. Therefore, the potential for the Proposed Scheme impacts on the identified soil receptors during the operational stage has been discounted from further assessment.

Elements Scoped into the Assessment

Construction Stage

13.4.13 The following elements are considered to have the potential to give rise to likely significant effects during construction of the Proposed Scheme and have therefore been considered within this assessment:

- Potential effects on construction workers' health from pre-existing contamination within the underlying soils/groundwater during construction activities;
- Potential effects on adjacent third-party neighbours from potential contamination within the underlying soils during construction activities;
- Potential effects associated with construction activities impacting the former Attlebridge Landfill;
- Potential effects on Controlled Waters and Groundwater dependent terrestrial ecosystems (GWDTE) during construction activities;
- Potential effects associated with construction activities impacting below ground services and building structures;
- Potential effects associated with construction activities impacting agricultural soils; and
- Potential effects associated with construction activities impacting soil resource and function.

13.4.14 This chapter sets out the assessment of the potential effects from chemical contamination on Controlled Waters. Potential effects relating to physical contamination (i.e., sediment) and changes to groundwater recharge and flow are considered within **Chapter 12: Road Drainage and the Water Environment** (Document Reference 3.12.00).

13.4.15 Impacts to flora and fauna are more comprehensively covered within **Chapter 10: Biodiversity** (Document Reference: 3.10.00).

13.4.16 Impacts on mineral deposits as a resource are discussed further within **Chapter 14: Material Assets and Waste** (Document Reference: 3.14.00).

Extent of the Study Area

13.4.17 The Red Line Boundary includes all areas of land required temporarily or permanently for the construction and operational activities of the Proposed Scheme. This includes the Site Boundary, areas for Environmental Enhancement and Essential Mitigation, and areas identified as No Work Zones.

13.4.18 The Site Boundary is the areas within which the main engineering works (structures, carriageway, drainage, earthworks, etc) will be undertaken, including areas for temporary use during construction such as works compound , storage sites, and welfare facilities. For impacts to human health and Controlled Water receptors the Study Area considered for this assessment consists of the area within the Site Boundary, as well as identified receptors within a 250 metre buffer zone from the Site Boundary. This Study Area extends up to 1 kilometre from the Site Boundary in relation to sensitive Controlled Water receptors only, which is considered appropriate for indirect effects.

13.4.19 Impacts to agricultural land and soil function are considered within the Red Line Boundary only with no buffer beyond.

13.4.20 These will be referred to as ‘250m study area’, ‘1km study area’ and ‘Soils study area’ respectively.

13.4.21 The 250m distance is referenced in best practice documentation (**Ref 13.34**), and is typical at the hazard identification stage of an assessment based on professional judgement. Consideration has

been given to the study area selected and, based on the specifics of the land within the Red Line Boundary (such as the underlying geology, an appreciation of the water environment and previous land use) the buffer zone extends up to 1 kilometre for Controlled Water receptors which is considered suitable and sufficient to account for any likely significant effects. This relates to the nature of potential effects to these receptors which are associated with intrusive engineering works.

13.4.22 Where features or receptors are identified as on-site or off-site this indicates that they either fall inside or outside of the Site Boundary. Site-won materials are considered to comprise of natural soils and/or Made Ground recovered from within the Site Boundary during earthworks most likely to occur during the construction phase.

Method of Baseline Data Collation

Desk Study

13.4.23 Data for the baseline conditions for the Proposed Scheme was taken from the Interpretative Environmental Desk Study Report (**Appendix 13.1**) (Document Reference: 3.13.01). The Desk Study Report includes several Envirocheck reports which are also included within **Appendix 13.1**.

13.4.24 Information has been requested from the North Norfolk District Council (NNDC), Broadland District Council (BDC) and the Environment Agency (EA) to supplement this baseline information. The information provided by these consultees has been reviewed and is not considered to alter the assessment of the baseline conditions.

Site Visit and Surveys

13.4.25 A ground investigation was undertaken in four phases:

- August 2019 to November 2019;

- August 2020 to September 2020;
- September 2021 to December 2021; and
- May 2022 to October 2022.

13.4.26 The ground investigation scope included obtaining information for contaminated land and geotechnical design. The Generic Quantitative Risk Assessment (GQRA) dated October 2021, and Ground Contamination Interpretative Report (GCIR) dated April 2023 which interpret the data from these investigations are contained within **Appendix 13.2** (Document Reference: 3.13.02).

Assessment Methodology

13.4.27 The EA's LCRM guidance, advocates the use of a conceptual risk model (Conceptual Site Model). The basis of this approach comprises three elements: a source, a pathway and a receptor. Without each of these, there can be no contamination risk. Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface does not automatically imply that a contamination risk exists, since the contamination must be defined in terms of pollutant linkages and unacceptable risk of harm. The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the intended use of the site, its characteristics and its surroundings. The potential for harm to occur requires three conditions to be satisfied:

- The presence of substances (potential contaminants or pollutants) that may cause harm (the 'Source' of pollution);
- The presence of a receptor that may be harmed (e.g., Controlled Waters or humans, an organism, an ecosystem, or Part 2A receptors such as buildings, crops or animals) (the 'Receptor'); and

- A route by which a receptor is or could be affected by a contaminant ('the Pathway').

13.4.28 Such an approach recognises that risks relating to land contamination can only exist where all three elements are present constituting a complete contaminant linkage.

13.4.29 LCRM has been used as a technical framework in the understanding of how contamination issues that may arise could be managed.

13.4.30 The Conceptual Site Model has been used to identify and assess the potential effects on the identified sensitive receptors (including human health, Controlled Waters, buildings and services) and outline mitigation measures to manage the risks identified in the assessment. The assessment has been prepared in accordance with the legislation and guidance referenced in **Section 13.2**.

13.4.31 The level of risk has been evaluated in accordance with the methodology set out in CIRIA C552: Contaminated Land Risk Assessment: A guide to good practice (CIRIA, 2001). This involves classification of the consequence and probability associated with each potential contaminant linkage and thereby the corresponding level of risk (risk category).

13.4.32 The framework for classifying of consequence, presented in full in Table 6.3 of CIRIA C552, is summarised in **Table 13-2** below. The consequence classification does not depend on the probability that the consequence will be realised. The 'severe' consequence classification describes acute risk (arising from short-term exposure). The 'medium' classification describes chronic harm (and may constitute 'significant harm' under Part 2A of the Guide).

Table 13-2 Qualitative risk assessment – classification of consequence

Classification	Definition
Severe	Severe short-term (acute) risks to human health, likely to result in significant harm. Short-term risk of pollution of sensitive water resource. A short-term risk to a particular ecosystem, or an organism forming part of such an ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or an organism forming part of such an ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings / structures / services or to the environment.
Minor	Harm, not necessarily significant, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health. Easily repairable effects of damage to buildings, structures and services.

13.4.33 The framework for classifying probability, presented in full in Table 6.4 of CIRIA C552, is summarised in **Table 13-3** below.

Table 13-3 Qualitative risk assessment – classification of probability

Classification	Definition
High Likelihood	There is a contaminant linkage and an event that appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	It is probable that an event will occur. Whilst not inevitable, it is possible in the short term and likely over the long term.
Low Likelihood	Circumstances are possible under which an event could occur, but it is not certain that (even over a long time period) such an event would occur.
Unlikely	It is improbable that an event would occur even in the very long term.

13.4.34 The level of risk (risk category), ranging from 'very high risk' to 'very low risk', is determined by the consequence and probability classifications using the matrix presented in full in Table 6.5 of CIRIA C552 and shown in **Table 13-4** below.

Table 13-4 Qualitative risk assessment – risk category

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

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

Agricultural Land Classification (ALC) and Soil Function Assessment

13.4.35 The assessment of ALC and soil function is distinct and separate from the methodology followed for contaminated land assessment as described in paragraphs 13.4.27 to 13.4.34. The assessment methodology for ALC and soil function is described below.

13.4.36 In order to categorise agricultural land receptor sensitivity, the methodology in DMRB LA 109 states that an ALC survey is required where data is not already available for agricultural land. The Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land lays out the methodology to assign Grades to agricultural land. The process considers site, climate and soil conditions at a site. MAFF and NPPF defines best and most versatile (BMV) land as land of excellent (ALC Grade 1), very good (Grade 2) and good (Subgrade 3a) agricultural quality. BMV land is afforded a degree of protection against development within planning policy. Lower-quality Subgrade 3b and Grades 4 and 5 land is restricted to a narrower range of agricultural uses.

13.4.37 Following IEMA A New Perspective on Land and Soil in Environmental Impact Assessment (2022), the gradation of sensitivities from very high to negligible is not necessarily one of discrete categories for all of the soil functions, and it is not possible to anticipate all possible permutations of soil resources and soil

functions. Therefore, this process involves an element of professional judgement.

13.4.38 It is also recognised that some soils are more sensitive to damage when handled during construction than others. Where peat disturbance by construction activities cannot be avoided, special measures are required for their handling. As with mineral soils, where peats and peaty soils are disturbed by development, they must also be conserved by stripping and storing for subsequent reinstatement and beneficial use following construction, but by applying special techniques.

13.4.39 Soil contamination reduces soil health and soil functionality. With regards to potential contamination impacts to ALC grade, land is not graded higher than Subgrade 3b if it is considered to be unsuitable for growing crops for direct human consumption. Land which is limited to grass production and on which there are significant restrictions on grassland management will be no better than Grade 4. Where only extensive grazing is possible the land will be Grade 5 and, where it is unfit for all forms of agricultural production, can be regarded as non-agricultural.

Assessment of Significance

13.4.40 The significance of the effects for land contamination has been assessed by comparing the difference in risk for each contaminant linkage for baseline conditions to those at the construction phase and operational phase. Where there is shown to be a decrease in contamination risk, the Proposed Scheme is assessed as having a beneficial effect on the environment in the long term.

13.4.41 The significance of effects to agricultural land is based on the permanent or temporary land take impacts or reduction in soil functions as a result of the Proposed Scheme.

Receptor Value/Sensitivity

13.4.42 Assessment of receptor value (sensitivity) for geology and soils follows the procedure described in **Table 13-5** which is set out in the DMRB Sustainability & Environmental Appraisal, LA 109 Geology and Soils (Table 3.11). Negligible sensitivity has been removed, as it is deemed irrelevant as no receptor (in terms of ground conditions) is classed as negligible.

13.4.43 Factors that may affect the sensitivity of the likely receptor include:

- Human receptors: age, weight, sex, duration on-site and distance from the Site Boundary;
- Controlled Waters receptors: distance from the Boundary and resource potential; and
- Agricultural land and soil receptors: resource quality, soil health and functions based on current or previous land uses.

13.4.44 Soils not categorised as BMV or prime land can be allocated a higher sensitivity category where particular agricultural practices contribute to the quality and character of the environment or local economy (e.g. in upland areas where lower quality agricultural land is integral to agricultural practices). No agricultural practices contributing to the quality and character of the environment or local economy were identified in the agricultural land and soil study area.

Table 13-5 Classification of value (sensitivity) of resources

Receptor value (Sensitivity) importance	Criteria	Attribute	Typical examples
Very High	Very rare and of international importance with no potential for replacement. Geology meeting international designation citation criteria which is not designated as such.	Geology	UNESCO World Heritage Sites, UNESCO, Global Geoparks, SSSI and Geological Conservation where citations indicate features of international importance. Review sites where citations indicate features of international importance.
Very High	Soils directly supporting an EU designated site. Agricultural land.	Soil Resource and Soil Function	Biomass production: ALC Grades 1 & 2. Ecological habitat, soil biodiversity and platform for landscape: Soils supporting protected features within a European site (e.g., SAC, SPA, Ramsar); Peat soils; Soils supporting a National Park, or Ancient Woodland. Soil carbon: Peat soils, Soils with potential for ecological/landscape restoration Soil hydrology: Very important catchment pathway for water flows and flood risk management. Archaeology, Cultural heritage, Community benefits and Geodiversity: SAMs and adjacent areas; World Heritage and European designated sites; Soils with known archaeological interest; Soils supporting community/recreational/educational access to land covered by National Park designation. Source of materials: Important surface mineral reserves that would be sterilised (i.e., without future access.
Very High	Human health: very high sensitivity land use.	Contamination	Residential or allotments.
Very High	Nationally significant attribute of high importance.	Groundwater	Principal Aquifer providing a regionally important resource and / or supporting a site protected under European Commission (EC) and UK legislation Ecology and Nature Conservation. Groundwater locally supports Groundwater dependent terrestrial ecosystem (GWDTE) or Source Protection Zones (SPZ) 1.

Receptor value (Sensitivity) importance	Criteria	Attribute	Typical examples
High	Rare and of national importance with little potential for replacement. Geology meeting national designation citation criteria which is not designated as such.	Geology	Geological SSSI, National Nature Reserves (NNR).
High	Soils directly supporting a UK designated site. Agricultural land.	Soil Resource and Soil Function	Biomass production: ALC Grade 3a. Ecological habitat, soil biodiversity and platform for landscape: Soils supporting protected features within a UK designated site (e.g., UNESCO Geoparks, SSSI or AONB, Special Landscape Area, and Geological Conservation Review sites); Native Forest and woodland soils; Unaltered soils supporting semi-natural vegetation. Soil carbon: Organo-mineral soils (e.g., peaty soils). Soil hydrology: Important catchment pathway for water flows and flood risk management. Archaeology, Cultural heritage, Community benefits and Geodiversity: Soils with probable but as yet unproven (prior to being revealed by construction) archaeological interest; Historic parks and gardens; Regionally Important Geological Sites (RIGS); Soils supporting community/recreational/educational access to RIGS and AONBs. Source of materials: Surface mineral reserves that would be sterilised (i.e. without future access).
High	Human Health: high sensitivity land use.	Contamination	Construction and maintenance workers (where extensive earthworks, and demolition of buildings are proposed). Public Open Space.
High	Locally significant attribute of high importance.	Groundwater	Principal Aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE or SPZ 2.

Receptor value (Sensitivity) importance	Criteria	Attribute	Typical examples
Medium	Of regional importance with limited potential for replacement. Geology meeting regional designation citation criteria which is not designated as such.	Geology	Regionally Important Geological Sites (RIGS).
Medium	Soils supporting non-statutory designated sites. Agricultural land.	Soil Resource and Soil Function	Biomass production: ALC Grade 3b. Ecological habitat, soil biodiversity and platform for landscape: Soils supporting protected or valued features within non-statutory designated sites (e.g. Local Nature. Reserves (LNR), Local Geological Sites (LGSs), Sites of Importance for Nature Conservation (SINCs), Special Landscape Areas; Non-Native Forest and woodland soils. Soil carbon: Mineral soils. Soil hydrology: Important minor catchment pathway for water flows and flood risk management. Archaeology, Cultural heritage, Community benefits and Geodiversity: Soils with possible but as yet unproven (prior to being revealed by construction) archaeological interest; Soils supporting community/recreational/educational access to land. Source of materials: surface mineral reserves that would remain accessible for extraction.
Medium	Human Health: medium sensitivity land use.	Contamination	Construction workers (where limited earthworks, are proposed). Commercial or Industrial.
Medium	Of moderate quality and rarity	Groundwater	Aquifer providing water for agricultural or industrial use with limited connection to surface water. Source Protection Zone 3 .
Low	Of local importance / interest with potential for replacement	Geology	Non-designated geological exposures, former quarries / mining sites.

Receptor value (Sensitivity) importance	Criteria	Attribute	Typical examples
Low	Soils supporting non-designated notable or priority habitats. Agricultural land.	Soil Resource and Soil Function	Biomass production: ALC Grades 4 & 5. Ecological habitat, soil biodiversity and platform for landscape: Soils supporting valued features within non-designated notable or priority habitats/landscapes. Agricultural soils. Soil carbon: Mineral soils. Soil hydrology: Pathway for local water flows and flood risk management. Archaeology, Cultural heritage, Community benefits and Geodiversity: Soils supporting no notable cultural heritage, geodiversity nor community benefits; Soils supporting limited community/recreational/educational access to land. Source of materials: Surface mineral reserves that would remain accessible for extraction.
Low	Low sensitivity land use	Contamination	Construction and maintenance workers (Minimal disturbance of ground). Infrastructure (roads, bridges, railways, buildings).
Low	Lower quality	Groundwater	Unproductive strata.

Magnitude

13.4.45 The expected magnitude of impact to each identified attribute and receptor has been assigned in accordance with the principles established in DMRB LA 109 (Table 3.12) and DMRB LA 104 (Table 3.4N), along with professional judgement. The terms used to describe magnitude of impact are defined in **Table 13-6**.

Table 13-6 Classification of magnitude of effect

Magnitude of Effect	**Reaction**	**Definition**
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.	No loss or alteration of characteristics, features or elements; no observable impact in either direction.
Negligible	Adverse	Very minor loss or detrimental alteration to one or more characteristics, features or elements. No discernible loss or reduction or improvement of soil functions or soil volumes that restrict current or proposed land use.
Negligible	Beneficial	Very minor benefit to or positive addition of one or more characteristics, features or elements. No discernible loss or reduction or improvement of soil functions or soil volumes that restrict current or proposed land use.

Magnitude of Effect	Reaction	Definition
Minor	Adverse	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Permanent, irreversible loss over less than 5ha or a temporary, reversible loss of one or more soil functions or soil volumes), or temporary, reversible loss of soil features set out in **Table 13-5**.
Minor	Beneficial	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduction in the risk of negative impact occurring. Potential for permanent improvement in one or more soil functions or soil volumes due to remediation or restoration over an area of less than 5ha soil-related features set out in **Table 13-5**.

Magnitude of Effect	Reaction	Definition
Moderate	Adverse	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements; short-term exposure to contaminants with chronic (long-term) toxicity. Permanent, irreversible loss of one or more soil functions or soil volumes, over an area of between 5 and 20ha of soil features set out in **Table 13-5**.
Moderate	Beneficial	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Major	Adverse	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements; exposure to acutely toxic contaminants. Greater than 20ha of soil features set out in **Table 13-5**.
Major	Beneficial	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality. Potential for permanent improvement in one or more soil functions or soil volumes due to remediation or restoration over an area of more than 20ha.

Significance Criteria

13.4.46 Once the sensitivity of the affected receptor or receiving environment to change and the magnitude of change have been established, the matrix presented in **Table 13-7**, which is based on Table 3.8.1 in DMRB LA 104 Environment Assessment and Monitoring, will be used to determine the significance of effect ranging from 'neutral' to 'very large'. The likely duration of the effect and likelihood of the effect occurring is also considered when assessing each effect.

13.4.47 Where a range has been provided, e.g., Moderate or Large, professional judgement has been used to define the significance. The effects are described as adverse and beneficial. An effect would be considered to be significant if assessed as moderate or above.

Table 13-7 Significance of effect matrix

Matrix	**Magnitude of Change (Impact) No Change**	**Magnitude of Change (Impact) Negligible**	**Magnitude of Change (Impact) Minor**	**Magnitude of Change (Impact) Moderate**	**Magnitude of Change (Impact) Major**
Sensitivity/ Value Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
Sensitivity/ **Value High**	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Sensitivity/ **Value Medium**	Neutral	Neutral or Slight	Neutral or Slight	Moderate	Moderate or Large
Sensitivity/ **Value Low**	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate

Matrix	**Magnitude of Change (Impact) No Change**	**Magnitude of Change (Impact) Negligible**	**Magnitude of Change (Impact) Minor**	**Magnitude of Change (Impact) Moderate**	**Magnitude of Change (Impact) Major**
Sensitivity/ **Value Negligible**	Neutral	Neutral or Slight	Neutral or Slight	Neutral or Slight	Slight

13.4.48 **Table 13-8**, which is based on Table 3.7 in DMRB LA 104, provides typical descriptions of these significance categories.

Table 13-8 Significance categories (effects) and typical descriptions

Significance Category	**Typical Description**
Very Large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Temporal Scope

13.4.49 The assessment of environmental impacts relating to ground conditions comprise of:

a) Short (two to five years) and medium term (five to ten years), temporary effects; and

b) Long term (ten or more), permanent effects.

13.5 Baseline Conditions

Study Area Description and Current Use

13.5.1 The Proposed Scheme comprises of approximately 6 kilometres of dual carriageway from the Broadland Northway (A1270) (formerly Norwich Northern Distributor Road) / Fakenham Road (A1067) intersection at the northern extents to the A47 at the southern Site Boundary extents.

13.5.2 The Proposed Scheme extends across the River Wensum flood plain to the north and the River Tud valley to the south. The route passes through farmland and woodland, crossing country lanes and roads within the local network. The Proposed Scheme will require the construction of sections of cuttings/embankments, roadway overpasses and underpasses, wildlife crossings, drainage features and landscaped verges.

13.5.3 One key feature of the Proposed Scheme will be the approach to the proposed junction with the A1067, where the alignment will cross the River Wensum by a viaduct. The viaduct will span over the river valley wetlands.

13.5.4 Due to the scale of the Proposed Scheme, the environmental and historical records obtained as part of the Interpretive Environmental Desk Study Report have been split up further into three different sections as defined below:

- **Chainage -172 – Chainage 550**: The area contains, the proposed viaduct that crosses the River Wensum flood plain and joins the A1067 at a new junction. The area also contains the upgraded section of the A1067 and a possible pond.
- **Chainage 550 – Chainage 3200**: Proposed section of road that continues from the east of Weston Green village to south of an ancient woodland adjacent to the west of the River Wensum flood plains. The area also includes a possible pond and two road crossing bridges.

- **Chainage 3200 – Chainage 5580**: Proposed section of road that runs from the A47 at Wood Lane to the east of Weston Green village. The area also includes two existing possible ponds and a road crossing bridge.

Surrounding Area

13.5.5 The surrounding area is predominantly agricultural or wooded land with occasional residential properties and farm buildings. Multiple villages are also present within the vicinity of the Proposed Scheme: Attlebridge to the north; Ringland to the east; Honingham to the south; and Weston Green and Weston Longville to the west. The Weston Green solar farm also lies to the west. The River Wensum and associated flood plain roughly runs from north-west to south-east crossing the Proposed Scheme in the northern section (at Chainage -172 – Chainage 550). Further afield to the east lie more densely populated residential areas on the western fringe of Norwich.

Study Area History

13.5.6 The history of the study area is summarised in **Table 13-9** - Summary of Historical Land Uses in Chainage 3200 – Chainage 5580; **Table 13-10** - Summary of Historical Land Uses in Chainage 550 – Chainage 3200 and **Table 13-11** - Summary of Historical Land Uses in Chainage -172 – Chainage 550, which have been taken from **Appendix 13.1** (Document Reference: 3.13.01).

Table 13-9 Summary of historical land uses in chainage 3200 – chainage 5580

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1883-1885 (1:10,560) 1883-1884 (1:10,560) 1882 (1:2,500) 1906 (1:2,500)	The Site Boundary generally comprises multiple undeveloped fields. Towards the north, a track associated with	An unnamed road runs approximately 60m to the south of the Site Boundary in a north west to south east orientation.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1907 (1:10,560)	Foxburrow Plantation transects the Site Boundary.	Two unnamed roads are noted 30m to the west and along the southern Site Boundary. An Old Marl Pit is located 185m north west of Site Boundary. An Old Clay Pit is located 193m north west of the Site Boundary. There are multiple ponds located within 250m of the Site Boundary in all directions.
1952 (1:10,560) 1957 – 1959 (1:10,000)	No significant change.	The Old Marl and Clay Pits are now unnamed and covered in vegetation.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1971 (1:2,500) 1971 – 1981 (1:2,500) 1976 (1:10,000) 1982 (1:10,000)	A junction, which now crosses the south of the Site Boundary, has been altered, now connecting Wood Lane to the west and with the A47 to the south.	Old Marl Pit is no longer shown, presumed infilled. Old Clay Pit is no longer shown, presumed infilled. Buildings (including Berry Hall Cottages and Merrywood House) within Honingham are located approximately 250m to the south west of Site Boundary.
1994 (1:2,500) 1999 (1:2,500) 2000 (1:10,000) 2006 (1:10,000) 2019 (1:10,000)	'Robin's Nursery' extends over the north of the Site Boundary, making up part of the Foxburrow Plantation. A stream present in Foxburrow Plantation is indicated to flow in a south easterly direction (likely to be Foxburrow Stream).	No significant change.
2023(Google Earth Review)	No significant change.	No significant change.

Table 13-10 Summary of historical land uses in chainage 550 – chainage 3200

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1883 – 1884 (1:10,560) 1882 (1:2,500) 1905 – 1906 (1:2,500) 1906 (1:2,500) 1907 – 1908 (1:10,560)	The Site Boundary generally comprises multiple undeveloped fields. The Site Boundary is transected by the Gravelpit plantation and an associated track (running from north to south), the Primrose plantation with associated tracks, the Long plantation in the east. Longrow Lane and an additional unnamed road running from north-west to south-east. The north easternmost section of the Site lies to the south of Rose Carr within the flood plains of the River Wensum.	Low Farm is located approximately 100m south of the Site Boundary. A Marl Pit is situated 234m north of the Site Boundary. An unnamed pond is located approximately 150m north west of the south-western extents of section covered by Chainage 550 – Chainage 3200. The River Wensum is situated approximately 220m east of the north eastern section covered by Chainage 550 – Chainage 3200.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1938 (1:10,560) 1938-1952 (1:10,560) 1957 (1:10,560) 1957 – 1959 (1:10,560)	No significant change.	Marl Pit is now unnamed and covered in vegetation.
1970 – 1971 (1:2,500) 1971 (1:2,500) 1974 – 1975 (1:2,500) 1973 – 1976 (1:10,560) 1975 – 1976 (1:10,560)	Longrow Lane has been changed to Ringland Lane.	Gravelpit plantation adjacent to the central section of the Proposed Scheme has reduced in size. A pond associated with the Rose Carr plantation is situated 170m north of the Site Boundary. Marl Pit is no longer shown, presumed infilled.
1994 (1:2,500) 1999 Aerial Photography (1:2,500) 2000 (1:10,000) 2006 (1:10,000) 2019 (1:10,000)	No significant change.	The pond associated with the Rose Carr plantation has reduced in size.
2023 (Google Earth Review)	No significant change.	No significant change.

Table 13-11 Summary of historical land uses in chainage 172 – chainage 550

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1882 (1:2,500) 1883 – 1884 (1:10,560) 1906 (1:2,500) 1907 – 1908 (1:10,560)	The Site Boundary generally made up of the flood plains of the River Wensum. The River Wensum also transects Site, running in an approximate north west to south east orientation. A track is present running in an approximate north west to south east orientation. Crooked Oaks plantation with an associated track is also situated in the eastern tip of Site Boundary. A Marl Pit extends on to the northern part of the Site Boundary.	An unnamed road runs from north west to south east adjacent to the south of Site Boundary. Attlebridge Hall is located adjacent to the River Wensum, and adjacent to the north western boundary of the Site Boundary. The Attlebridge Hills plantation is located approximately 25m north of Site Boundary.
1938 (1:10,560) 1957 (1:10,000)	A Marl Pit is noted on the northern Site Boundary and an unnamed area of vegetation encroaches into the Site Boundary.	No significant change.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1970 (1:2,500) 1975 (1:10,000) 1975 – 1976 (1:10,000)	The layout of the track is detailed as the A1067.	No significant change.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
1994 (1:2,500) 1999 Aerial Photography (1:2,500) 2000 (1:10,000) 2006 (1:10,000)	The A1067 is now detailed as Fakenham Road which, runs adjacent to the southern Site Boundary and also transects the alignment of the Proposed Scheme.	From the 2000 map edition, a refuse/slag heap and a shooting range is noted approximately 200m to the north-west and north-east of the Site Boundary.

Historical Map (Date and Scale)	Within the Site Boundary	Within the Study Area
2019 (1:10,000)	No significant change.	A roundabout has been constructed on A1067 to the east of the section covered by Chainage -172 – Chainage 550. This connects to the Broadland Northway to the east of Site Boundary. Attlebridge Hall to the north of Site Boundary is now renamed as Old Hall Cottages. The former refuse / slag heap and shooting range was relabelled as Attlebridge Landfill Site and as disused. The eastern boundary of the Wensum Valley Hotel Golf and Country Club is located adjacent to the south-eastern Site Boundary.
2023(Google Earth Review)	The former Marl Pit is noted on the northern Site Boundary.	No significant change.

Geology

13.5.7 The British Geological Survey (BGS) 'Geology of Britain' online viewer and BGS maps of Aylsham (Sheet 147 Bedrock and Superficial Deposits) and Norwich (Sheet 161 Solid and Drift Edition) were reviewed. The geology underlying the Red Line Boundary is summarised in **Table 13-12** - Summary of geology.

Table 13-12 Summary of geology

Superficial or Bedrock	Strata	Distribution Across the Red Line Boundary
Superficial	Alluvium	This unit is present in a band towards the north of the Red Line Boundary within the vicinity of the A1067.
Superficial	Head Deposits and River Terrace Deposits	Both of these units are present alongside alluvium deposits towards the north of the Red Line Boundary.
Superficial	Sheringham Cliffs Formation	Dominates the superficial deposit cover across the majority of the Red Line Boundary.
Superficial	Lowestoft Formation	The unit is present only at the very south of the Red Line Boundary in the vicinity of the A47.

Superficial or Bedrock	Strata	Distribution Across the Red Line Boundary
Superficial	Happisburgh Glacigenic Formation	Potentially present in localised areas across the Red Line Boundary.
Bedrock	Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated)	The unit underlies the entirety of the Red Line Boundary.

13.5.8 Four publicly available borehole logs within the vicinity of the Red Line Boundary were reviewed. Of the reviewed logs, TG11SW3 was located towards the south of the Red Line Boundary, TG11SW11 in the centre south, TG11SW16 in the centre north and TG11NW99 in the north. The logs are presented in **Appendix 13.1** (Document Reference: 3.13.01) and a summary of the logs is presented in **Table 13-13**.

Table 13-13 Summary of publicly available borehole logs

Stratum	Base of Stratum (m bgl)	Thickness of Stratum (m)	Typical Description	BGS Boreholes
Topsoil (in south of the Red Line Boundary)	0.20 – 0.30	0.20 – 0.30	Topsoil.	TG11SW3 TG11SW11 TG11SW16

Stratum	Base of Stratum (m bgl)	Thickness of Stratum (m)	Typical Description	BGS Boreholes
Made Ground (in north of the Red Line Boundary)	1.20	1.20	Orange silty fine sand with some fine and medium flint gravel.	TG11NW99
Clay (in south and centre of the Red Line Boundary)	17.70 – 18.20	0.90 – 17.64	Brown and Grey clay Brown / Grey sandy / stoney clay. Grey Chalky clay.	TG11SW3 TG11SW11 TG11SW16

Stratum	Base of Stratum (m bgl)	Thickness of Stratum (m)	Typical Description	BGS Boreholes
Sand (in south and north of the Red Line Boundary)	8.00 – 19.50	1.80 – 14.60	Gravelly sand. Sand is fine to medium. Gravel is fine to coarse, subangular flint. Orangey brown silty fine sand with laminae of grey sandy silt. Brown clayey silty fine sand with much fine and medium flint gravel.	TG11NW99 TG11SW3 TG11SW11 TG11SW16
Silt (in north of the Red Line Boundary)	1.20 – 5.60	0.80 – 2.00	Brown very clayey very sandy silt with some fine and medium flint gravel. Laminated grey very clayey sandy silt.	TG11NW99

Stratum	Base of Stratum (m bgl)	Thickness of Stratum (m)	Typical Description	BGS Boreholes
Chalk (in north and south of the Red Line Boundary)	20.45 (Full extent not proven)	12.45 (base unproven)	Off white silty sized comminuted Chalk with a little fine intact Chalk.	TG11NW99 TG11SW3 TG11SW11 TG11SW16

Hydrogeology and Hydrology

13.5.9 The EA classifies each geological unit as the following:

- Alluvium – Secondary B Aquifer;
- Head Deposits – Secondary B Aquifer;
- River Terrace Deposits – Secondary A Aquifer;
- Sheringham Cliffs Formation – Secondary A Aquifer;
- Lowestoft Formation – Secondary Undifferentiated Aquifer;
- Happisburgh Glacigenic Formation – Secondary Undifferentiated Aquifer; and
- Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation – Principal Aquifer.

13.5.10 The Proposed Scheme is located within a Source Protection Zone 3 (SPZ) for total catchment. Groundwater abstraction data has been provided by the EA. There are six private water supply permits within 1 kilometre of the Site Boundary one of which is located within the Red Line Boundary. The EA provided details of four public water supply licences however these are outside the Study Area of this chapter. Further detailed information

regarding aquifer information and abstractions is contained within **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00).

13.5.11 The River Wensum and associated flood plains cross the Site Boundary towards the north. Multiple small unnamed inland surface water drains also fall within the Site Boundary. The River Tud runs approximately 400m south of the Site Boundary oriented east to west.

13.5.12 The closest surface water abstraction is from the River Wensum at Ringland within the north western Site Boundary. This extraction was used for general agriculture for direct use and storage for spray irrigation.

Preliminary Hydrogeology Model

13.5.13 Made Ground is likely to be present in the north of the Proposed Scheme due to historical development, however the thickness and composition are likely to be highly variable. Groundwater may be present as perched water within the Made Ground, associated with lenses of permeable material which are recharged by surface water infiltration.

13.5.14 The underlying Chalk bedrock has been classified as a Principal Aquifer. Groundwater is anticipated to present within the Chalk, at approximately 14.60m to 15.50m bgl, based on information recorded on historical borehole logs. Within historic borehole logs, groundwater was not encountered within the superficial deposits. However, should groundwater be present within superficial deposits, it is likely that it will be in hydraulic continuity with groundwater within the Chalk aquifer.

Future Climate Change under RCP8.5 Scenario

13.5.15 The following potential climate change impacts have been considered following Society of Brownfield Risk Assessment methodology (**Ref 13.32**).

Sea Level Rise/Flood Risk

13.5.16 The Proposed Scheme is currently located approximately 13 kilometres from the tidal River Yare (to the south east) and approximately 35

kilometres from the North Sea (to the east) with the lowest elevation in the north of the Proposed Scheme approximately 20m AOD along the River Wensum floodplain. Under RCP8.5 sea level along the coast in proximity to the site is projected to rise by >0.7m by 2100 however due to the distance of the Proposed Scheme from the tidal influence of the River Yare and North Sea, it is unlikely to be adversely impacted by potential future sea level rise, tides, and storm surge under RCP8.5 scenario.

13.5.17 Flood risk projections under climate change is provided within **Chapter 12: Road Drainage and Water Environment** (Document Reference: 3.12.00).

Projected Changes to Groundwater Level

13.5.18 The Proposed Scheme is located within Broadlands River Chalk & Crag Groundwater catchment which falls under the WFD definition of groundwater body. The eFLaG project far-future (2050-2079) (**Ref 13.35**) projections for groundwater recharge within this catchment report a 0.1mm per day decrease for autumn months and a 0.1mm per day increase for the winter months for this groundwater body. No change to current recharge is indicated for other seasons. This indicates potential future increases in groundwater level, at least during winter, and similar decreases in autumn, relative to the current baseline. These projections do not take account of extreme weather events but rather longer term trends.

13.5.19 Far-future median projections for the nearest monitored borehole within the Chalk aquifer (Washpit Farm) indicates no significant groundwater level changes for this bedrock aquifer.

Mineral Resources and Waste Management

13.5.20 There are twelve BGS recorded mineral sites recorded within 250m of the Site Boundary. The closest mineral site comprises Attlebridge Hall Marl Pit adjacent to the north-western Site Boundary which was an opencast Chalk pit with a ‘ceased’ status (it is no longer operational).

13.5.21 The study area is not located within an area which may be affected by coal mining (as defined by the Coal Authority).

13.5.22 From a review of the Norfolk Minerals and Waste Development Framework Mineral Site-Specific Allocations Development Plan Document (**Ref 13.36**) it is evident that study area may intersect Sand and Gravel Safeguarded Areas. The nearest has been identified approximately 500m to the north-west of the proposed connection to Fakenham Road towards the northern extents of the study area. This safeguarded site comprises Land at Keepers Cottage (ref: MIN 55) which is 1.9ha in area and hosts an estimated sand and gravel resource of 525,000 tonnes.

13.5.23 The former Attlebridge Landfill is subject to a 250m safeguarding consultation zone. The northern extent of the Proposed Scheme falls within this zone. Based upon information from the EA it is understood the landfill, now closed previously operated on a dilute and disperse premise prior to moving to lined cells engineer solution.

13.5.24 **Chapter 14: Material Assets and Waste** (Document Reference: 3.14.00) should be referenced for full details and assessment of mineral resources within the study area.

Agricultural Land

13.5.25 Based upon pre-1988 ALC mapping the Proposed Scheme traverses through agricultural land provisionally classified as between Grades 3 ‘good to moderate’ and 4 ‘poor’. Land classified as Grade 2 ‘very good quality’ is present in the southern and western extents of the Soils Study Area. Pre-1988 mapping does not differentiate between Grade 3a (BMV) and Grade 3b (non-BMV) therefore it is not possible to attribute Grade 3 as either BMV or non-BMV based on a desk-based assessment alone.

13.5.26 A detailed Agricultural Land Classification and soil resources survey was undertaken in November 2022 (**Appendix 13.4** and **Appendix 13.5**) (Document References: 3.13.04 and 3.13.05) within the Site Boundary only. It should be noted that it was not possible to survey all areas within the Site Boundary at the time of survey. These areas are discussed below in relation to pe-1988 ALC mapping. In total, 130 soil profiles were

examined within the Site Boundary at an observation density of approximately one per hectare in accordance with the established recommendations for ALC surveys (**Ref 13.37**). Land within the River Wensum floodplain has been surveyed at a higher density as part of a soil resource survey investigating the potential for peat reserves in the area.

13.5.27 Agricultural land quality within the Site Boundary is primarily classified as Grade 2 (BMV), Subgrade 3a (BMV) and Subgrade 3b (non-BMV). Land within the River Wensum floodplain is restricted to Grade 4 (non-BMV) because of the flood risk. The ALC distribution within the Site Boundary overlaid with areas of temporary and permanent land take is shown in **Figure 13.1** in **Appendix 13.8** (Document Reference: 3.13.08) based upon the detailed **Agricultural Land Classification** (Document Reference 3.13.04).

13.5.28 **Figure 13.2** in **Appendix 13.8** (Document Reference: 3.13.08) shows the ALC grade distribution for all other areas within the Soils Study Area based upon pre-1988 ALC mapping overlaid with areas of temporary and permanent land take as well as areas proposed for Environmental Mitigation Areas and Water Framework Directive enhancements. Areas for proposed Environmental Enhancement and Mitigation include areas for woodland or scrub enhancement, woodland creation and grassland creation. Further details on these areas can be found in **Chapter 10: Biodiversity** (Document Reference: 3.10.00). Areas of proposed woodland / scrub enhancement are within areas of existing woodland which are therefore not in agricultural use and are considered non-agricultural within this assessment. Areas of woodland and grassland creation are considered to be permanent land take for this assessment. Within areas of Water Framework Directive enhancement limited agriculture (grazing) will still be possible.

13.5.29 **Table 13-14** provides a summary of the total area of each ALC grade and the area of each grade which is subject to temporary and permanent land take within the areas of the Site Boundary subject to the detailed ALC

survey. Permanent land take is considered to be agricultural land which will be permanently removed from use either for the Proposed Scheme and associated infrastructure or through Environmental Enhancement and Mitigation which does not include agriculture. Areas of temporary land take will be returned to their current use following construction of the Proposed Scheme.

13.5.30 The information within **Table 13-14** is taken from **Appendix 13.4** (Document Reference: 3.13.04), the detailed ALC survey. Minor variation in area of the Red Line Boundary have occurred since production of **Appendix 13.4**. **Table 13-14** represents the most up to date calculations, based on the boundary shown in **Figure 3.1** (Document Reference: 3.03.03). The calculations assume a worst case scenario where the Proposed Scheme permanently covers soils across River Wensum Floodplain. However, in reality, permanent land take will be restricted to viaduct piled foundations on crossing the floodplain, access tracks to maintain the viaduct and a public right of way.

13.5.31 **Table 13-15** provides a summary of areas within the Site Boundary and Red Line Boundary which were not part of the detailed ALC survey (see **Figure 13.2** in **Appendix 13.8**) (Document Reference: 3.13.08). This information is taken from Magic maps (Ref 13.38) to compliment the survey data for other areas.

Table 13-14 Summary of agricultural land classification and temporary and permanent land take (areas are approximate) based upon detailed ALC survey (Figure 13.1)

Grade	Description	Total Area (ha)	Temporary Construction Area (ha) (Temporary Land Take)	Site Boundary Area (ha) (Permanent Land Take)
Grade 2 (BMV)	Very good quality	11.25	3.27	7.98
Subgrade 3a (BMV)	Good Quality	18.23	5.49	12.74
Subgrade 3b (Non-BMV)	Moderate quality	95.54	29.97	65.57
Grade 4 (Non-BMV)	Poor Quality	5.91	2.95	2.96
Total Agricultural	Not applicable	130.93	41.68	89.25
Non-Agricultural	Not applicable	29.91	3.61	26.3
Total Non-BMV	Not applicable	101.45	32.92	68.53
Total BMV	Not applicable	29.48	8.76	20.72

Table 13-15 Summary of agricultural land classification and temporary and permanent land take (areas are approximate) based upon pre-1988 ALC mapping and Figure 13.2 for rest of Site Boundary and Red Line Boundary not subject to the detailed ALC survey

Grade	Description	Total Area (ha)	Temporary Construction Area (ha) (Temporary Land Take)	Site Boundary Area (ha) (Permanent Land Take)	Woodland / Scrub Enhancement (ha)	Woodland and Scrub Creation Areas (ha) (Permanent Land Take)	Grassland Creation (ha) (Permanent Land Take)	WFD (ha) (Permanent Land Take)
Grade 2 (BMV)	Very good quality	9.34	0	0	0	2.86	4.44	2.04
Grade 3 (BMV determination dependent upon survey)	Good to moderate quality	70.96	17.76	5.21	19.96	15.2	6.55	6.28
Grade 4 (Non-BMV)	Poor Quality	30.74	1.05	0	0	0	7.98	21.71

13.5.32 Based upon the detailed ALC survey the permanent land take of BMV land (ALC Grade 2 and 3a) required for the Proposed Scheme within the Site Boundary is approximate 20.72ha and the temporary land take of BMV land required for the Proposed Scheme within the Site Boundary to support construction activities is approximate 8.76ha, largely located in the southern extent of the Proposed Scheme.

13.5.33 For areas not subject to a detailed ALC survey, based upon pre-1988 mapping, the permanent land take of BMV land (Grade 2 only) is estimated to be 9.34ha. This permanent land take is for Environmental Enhancement and Essential Mitigation Areas. Based upon pre-1988 mapping alone it is not possible to determine the proportion of Grade 3 which is Grade 3a (BMV) or Grade 3b (non-BMV). However, the area of permanent Grade 3 land take within the Red Line Boundary is 33.24ha for areas of Environmental Enhancement and Mitigation. This does not include the area of proposed Woodland/Scrub Enhancement which is mapped as being 19.96ha of Grade 3 land because this is considered to be non-agricultural in nature as it is already used as woodland. Areas identified for the location of bat boxes and hedgerow enhancement have also not been included as it does not represent a change or impact to agricultural use. An additional area of 17.76ha of Grade 3 land is required temporary land take within the Red Line Boundary for Temporary Construction Areas.

13.5.34 Therefore, the total area of BMV anticipated to be required for the Proposed Scheme is conservatively estimated to be 89.82ha. This assumes worst case where all Grade 3 land is assumed to be Grade 3a (BMV), although this is unlikely. Of this total, 26.52ha is for temporary land take and 63.3ha is permanent land take.

River Wensum Floodplain Soils

13.5.35 A detailed survey of soil characteristics was undertaken in November 2022 (**Appendix 13.6**) to investigate and identify any peat reserves within the floodplain of the River Wensum where the viaduct is proposed. The survey

extended to 6.18ha of land within the floodplain of the River Wensum. Land within the survey area is in permanent pasture.

13.5.36 In total, 25 soil profiles were examined at an observation density of approximately four per hectare up to a maximum of 1.2m for any impenetrable layer. Two observation pits were also excavated to examine the subsoil. There are two soil types present within the survey area:

- Soil Type 1: The first soil type comprises those that include a peat loam or loamy peat subsoil at variable depths. Topsoil comprises very dark greyish brown to dark brown, heavy clay loam or sandy clay loam, with one recording of clay. The topsoil is organic, with laboratory analysis confirming 9.2% - 22.7% organic matter. The topsoil is considered an organic loam. The upper subsoil comprises black, very dark brown or very dark greyish brown, stoneless, loamy peat, with one recording of peaty loam. The laboratory analyses record organic matter contents of 12.0% - 36.7% and are classified as organic loam, loamy peat or peaty loam.
- Soil Type 2: The second soil type is found in three locations within the survey area where no peat was recorded within the soil profile. The topsoil comprises very dark grey, very dark greyish brown, dark brown or dark greyish brown, sandy clay loam or loamy sand, which is variably organic. The topsoil is friable and has a coarse granular to medium subangular blocky structure. The subsoil comprises grey, brown, yellowish brown or light yellowish brown, loamy sand or sandy clay loam.

13.5.37 A soil depth probing survey was also undertaken in November 2022 to ascertain the extent that peat may be present below 1.2m. For the depth probe survey 34 locations were surveyed. The measured soil depths ranged between 0.2m and 2.2m. Of the 34No. locations, 19No. locations had a depth of 0.5m or under, 8No. locations between 0.5 and 1m and 7No. locations over 1m.

13.5.38 Topsoils were typically classified as an organic loam with between 9.2%-22.7% organic matter content. In terms of subsoils, 21 of the depth probe survey points likely comprised loamy peat or peaty loam. Organic matter in these ranged between 12%-36.7%.

13.5.39 Peat (a soil with over 50% organic matter content) (**Ref 13.39**) was not detected by the survey. However, highly organic peaty soils were found to be present. There were seven instances where soil depth exceeded 1.2m. At four of these locations a sandy loam or loamy sand is the lowermost soil composition recorded. This suggests it is unlikely that peaty soil is present below these depths. However, at three sample points, peaty loam or loamy peat is present at 1.2m, implying that these soil types, and possibly peat, could be present at greater depths at these locations.

13.5.40 Although peat has not been detected by the survey, as a worse case assessment a peat carbon assessment is provided in **Chapter 15: Climate Greenhouse Gases** (Document Reference: 3.15.00) to account for disturbance.

Soil Function

13.5.41 National Soil Resources Institute's Soilscape mapping on Magic Map viewer indicates soils within the Soils Study Area includes slightly acid loamy and clayey soils with impeded drainage with moderate to high natural fertility comprising arable and grassland land cover (mostly along the southern extend of the Site Boundary) and freely draining slightly acid sandy soils with low natural fertility comprising arable land cover (within the northern extent of the Site Boundary).

13.5.42 Fen peat soils which are naturally wet and have mixed lime-rich to very low natural fertility are noted to be present in the northern extent of the Site Boundary associated with the River Wensum and largely define Flood Zone 3 indicating a connection with soil hydrology. Loamy and sandy soils with naturally high groundwater and a peaty surface are present within the vicinity of surface water features surrounding the A47 towards the south of

the Soils Study Area. Flood risk is assessed within **Chapter 12: Road Drainage and Water Environment** (Document Reference: 3.12.00).

Environmentally Sensitive Sites

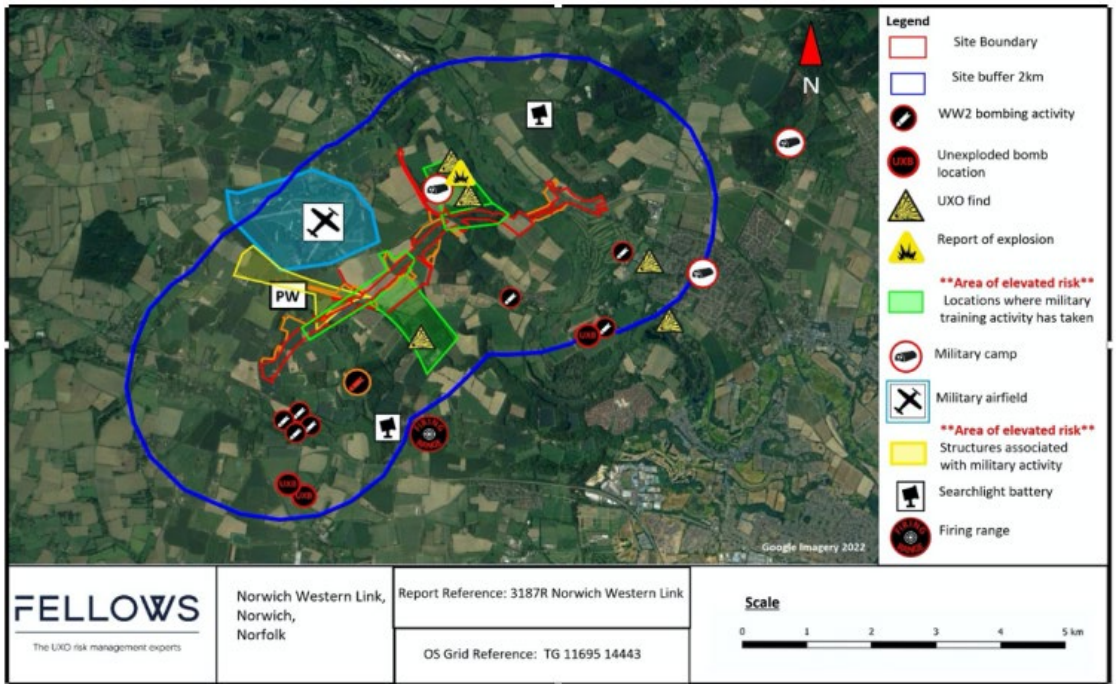
13.5.43 The Proposed Scheme is located within a surface water and groundwater Nitrate Vulnerable Zone (NVZ), an area designated as being at risk from agricultural nitrate pollution. There is a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) within the 1km study area. Both the SSSI and SAC, are related to the River Wensum under the Water Framework Directive (WFD).

Unexploded Ordnance (UXO)

13.5.44 A detailed unexploded ordnance risk assessment was carried out as part of the Geotechnical desk study by MACC International Limited (**Ref 13.40**) and a peer review subsequently undertaken by Fellows International Ltd (**Ref 13.41**). The reports identify numerous historic bombing incidents within proximity of the Site Boundary although none within the Site Boundary. The reports also highlight the risks associated with historic WW2 military training activities at Morton Hall Estate as well as RAF Attlebridge.

13.5.45 The risk associated with German air-dropped weapons and British anti-aircraft munitions was assessed as Low, however the risk from other munitions within zoned areas of the Proposed Scheme as shown on **Figure 13.1** below was assessed as Medium where there is an elevated risk.

Figure 13.1 Area of elevated medium risk (in green) along route of Proposed Scheme (taken from Figure 2 from detailed UXO risk assessment – peer review (Ref 13.41))



Potentially Contaminative Land Uses or Features

13.5.46 The Envirocheck report includes information and data collected from several organisations including the EA, the local authority, the British Geological Survey (BGS), Department for Environment, Food & Rural Affairs (Defra) and Health & Safety Executive (HSE).

13.5.47 A summary of the most pertinent information relevant to the Proposed Scheme is listed in **Table 13-16** below.

Table 13-16 Summary of database searches in respect of potentially contaminative land uses or features (all distances are approximate)

Descriptor	Within the Site Boundary	Within the Study Area 0-250 m	Within the Study Area 251-500 m	Details
Discharge Consents	0	1	1	Closest located 51m north-east of the Site Boundary, at BDR Grain Store on Stony Lane, entailing a discharge onto land, which was issued in January 1989 and revoked October 1996.
Integrated Pollution Prevention and Control	0	0	1	One record relating to Biffa Waste Services Ltd located 455m north-east of the Site Boundary. The status is 'superseded by variation.'

Descriptor	Within the Site Boundary	Within the Study Area 0-250 m	Within the Study Area 251-500 m	Details
Pollution Incidents to Controlled Waters	1	5	1	One record located on the northern part of the Site Boundary relating to the release of an unknown pollutant to a freshwater stream/river in December 1993. There are five records identified within the 1km study area which include the release of pollutants including oil and organic wastes: cattle manure (solid).

Descriptor	Within the Site Boundary	Within the Study Area 0-250 m	Within the Study Area 251-500 m	Details
Licensed Waste Management Facilities (Landfill Boundaries)	0	0	2	Two records 233m north-east and 301m east of the Site Boundary, both relating to the Attlebridge Landfill.
Licensed Waste Management Facilities (Locations)	0	0	2	Two records 301m east and 398m north-east of the Proposed Scheme both relating to land/premises at Reepham Road.
Potentially Infilled Land (non-water)	1	4	4	One record located towards the north of the Study Area recorded as unknown filled ground (pit, quarry etc). The 1884 map indicated this was a Marl Pit and labelled as an area of scrubland from the 1975 map edition.

Descriptor	Within the Site Boundary	Within the Study Area 0-250 m	Within the Study Area 251-500 m	Details
Historical Landfill Sites	0	0	1	Deighton Hills landfill 300m east of the Site Boundary and received deposited waste including inert waste between December 1980 and December 1985

Descriptor	Within the Site Boundary	Within the Study Area 0-250 m	Within the Study Area 251-500 m	Details
Registered Landfill Sites	0	0	2	Two records within 500m of the Site Boundary. Deighton Hills is located 331m east which accepted construction and demolition waste, the record is noted to be superseded. The other record is also from Deighton Hills and located 349m east and accepted wastes including concrete waste and hardcore and rubble. The record is noted to be lapsed or cancelled.

Summary of Contaminated Land Assessment

13.5.48 **Table 13-17** provides a summary of the potential sources of contamination that may be present within the study area, as well as the likely nature of such sources. This is based on the information obtained from the historical maps, the Envirocheck report and information on likely contaminants

associated with the study area's historical land uses contained within **Appendix 13.1** (Document Reference 3.13.01).

Table 13-17 Potential sources of contamination within the Site Boundary

Potential Sources of Contamination	**Potential Contaminants of Concern**	**Likely / Anticipated Distribution**
Within the Site Boundary	Not applicable	Not applicable
Potential Made Ground	Range of contaminants including metals, inorganics (e.g., cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide), vapours and asbestos.	Towards the north of the Site Boundary & where tracks / roads transect.
Potentially infilled land	Ground gas (carbon dioxide and methane)/vapours, PAHs, heavy metals, petroleum, hydrocarbons and asbestos.	Towards the north of the Site Boundary
Alluvium	Ground gas (carbon dioxide and methane).	Towards the north of the Site Boundary
Agricultural Practices	Fertilisers and pesticides (including 'spray disposal area').	Across the entire Site Boundary.
Plantations	Fertilisers and pesticides	Multiple locations across the entire Site Boundary.

Potential Sources of Contamination	Potential Contaminants of Concern	Likely / Anticipated Distribution
Historical Sewage Works	Range of contaminants including metals, inorganics (e.g., cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide), and vapours.	To the north of the western section of the Tributary of the Tud (Foxburrow Stream).
Within the Study Area	Not applicable	Not applicable
Potential Made Ground	Range of contaminants including metals, inorganics (e.g., cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide) and asbestos.	Predominantly to the north of the study area.
Agricultural Practices	Fertilisers and pesticides	Entire study area.
Plantations	Ground gas (carbon dioxide and methane), PAHs, heavy metals, petroleum, hydrocarbons and asbestos.	Multiple locations within the Site Boundary.
Historically in-filled Clay and Marl Pits and Attlebridge Landfill	Ground gases, PAHs, heavy metals, petroleum, hydrocarbons and asbestos.	Multiple locations towards the north of the study area.

Site Investigation

13.5.49 The intrusive site investigation was undertaken from 27 September 2021 to 15 December 2021.

13.5.50 The intrusive ground investigation works comprised of 16 cable percussive boreholes, 17 rotary boreholes (the majority follow on from cable percussion), 37 windowless sample boreholes, 55 trial pits and 19 pavement cores.

13.5.51 Soil sampling and analysis was undertaken on 123 samples with 34 subjected to leachate testing and 26 groundwater samples chemically analysed.

13.5.52 Four ground gas monitoring rounds were undertaken monthly from February to May 2022 (inclusive). Six groundwater monitoring rounds were undertaken at monthly intervals from February to May and in July and September 2022. One round of groundwater sampling was conducted in February 2022, with a total of nine groundwater samples obtained. Two further groundwater sampling rounds took place in December 2022 and February 2023. See **Appendix 13.2** and **Appendix 13.3** for full assessment.

13.5.53 Twelve hand excavated inspected pits and soil and surface water testing were also undertaken in March 2023 on the banks of Foxburrow Stream (assessed within **Appendix 13.7**)

13.5.54 Asphalt was recorded at five locations located on a road with a thickness range of 0.02-0.4m.

13.5.55 Surfacing of topsoil was present across the majority of the locations across land regularly used for farming with a thickness range between 0.1-0.8m. Made Ground was encountered with a thickness between 0.1-0.8m.

13.5.56 Superficial deposits were observed with a thickness range of 0.5 – 34.9m comprising peat (later determined to be peaty loam see Appendix 13.5 Document Reference 3.13.05), alluvium and river terrace deposits

encountered across the floodplain. The Lowestoft Formation (Glacial Till) was encountered across the site and was typically found overlying the Chalk. Due to the similarities in the till encountered, the glacial deposits have been grouped together as the Lowestoft Formation. The thickness was found to generally increase as the site approaches the A47. The Sheringham Cliffs Formation (granular glacial deposits) were encountered across the site, with the thickness decreasing as the site approaches the A47. The Sheringham Cliffs Formation was typically encountered above the Lowestoft Formation and below the topsoil. Cohesive components of the Sheringham Cliffs Formation were typically found as pockets and lenses of varying thicknesses between the main granular components.

13.5.57 The underlying bedrock is Chalk, which comprises the undifferentiated components of the Lewes Nodular Chalk Formation, the Seaford Chalk Formation, the Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation. Chalk was encountered at 42 locations at depths varying from 2 – 60.5mbgl. There is no obvious trend of depth to the Chalk being greater in any particular area of the site.

13.5.58 Only 13 of the 45 installed monitoring wells had groundwater present. The remainder of the monitoring wells were found to be dry during all eight monitoring rounds. Groundwater levels in the Chalk varied from 12.08 to 36.50 m AOD. Given the lack of monitoring wells in the Chalk producing groundwater, it is not possible to determine an accurate groundwater direction. However, given these three data points, it suggests the groundwater within the Chalk is flowing to the north-east. This would be expected, as the groundwater is likely to flow towards the River Wensum in the north of the Proposed Scheme.

13.5.59 Ten monitoring wells were installed in the superficial deposits and groundwater levels ranged from 8.74 – 49.51 m AOD. Groundwater levels suggests that there is a general flow towards the north-east. Again, this is likely to represent the flow towards the River Wensum. The lack of water in many of the monitoring wells and the presence of a variety of granular and

cohesive material within the superficial deposits may indicate that the groundwater is not continuous within the various water bearing strata present within the superficial deposits.

13.5.60 Given the absence of any aquitards between the granular superficial deposits and the Chalk aquifer at many locations it is considered likely that groundwater is continuous between the superficial deposits and bedrock strata. Perched water may still be present within the superficial deposits above any layers of low permeability soils, but these are unlikely to present a separate groundwater body.

13.5.61 There was no recorded visual and olfactory signs of contamination observed during the investigation.

Risk Assessment

13.5.62 A Generic Quantitative Risk Assessment (GQRA) (an interpretive report of the ground investigations) was undertaken.

13.5.63 Based on the findings of the assessment the following conclusions are made.

Human Health

13.5.64 Chemical testing results from a total of 123 soil samples were screened against generic criteria for public open space. All concentrations were below relevant screen criteria with the exception of benzo(a)pyrene which was recorded above the screening criteria in the pavement cores in ten samples only.

13.5.65 Asbestos fibres were not detected in any of the tested samples.

13.5.66 It is noted that while no asbestos was detected in the samples subjected to analysis, there is the potential for asbestos to be identified elsewhere at within the Site Boundary in locations not targeted by the ground investigation. However, given the testing and site history, the likelihood of soils being contaminated by asbestos is considered to be low.

Controlled Waters

13.5.67 Metals including cadmium, copper, lead, mercury, nickel and zinc as well as cyanide were found to exceed Environmental Quality Standards (EQS) protective of surface waters. Two aromatic TPH fractions (C10-C12 and C12-C16) exceed the EQS within one borehole location on two monitoring occasions only. Exceedances were marginal and not considered to be significant.

13.5.68 Based on the assessment of the soil leachate and groundwater results, the risk to groundwater in the Alluvium, Sheringham Cliffs Formation and Chalk underlying the Site Boundary are considered to be Low. Risk to the River Wensum and tributaries from groundwater within the superficial deposits underlying the Site Boundary is considered to be Low.

13.5.69 This assessment is based upon the following:

- There are no sources of potential contamination identified such as contaminated Made Ground.
- The leachate exceedances are marginal and are likely to be associated with background concentrations of contaminants within the natural strata underlying the Site Boundary.
- The Proposed Scheme would introduce hardstanding at the road surface which would provide betterment and reduce infiltration of rainwater into the ground and therefore limit the mobilisation of potential contaminants of concern.
- Based on there being no historical development across the Site Boundary and limited Made ground deposits identified on the Site, the contaminants of concern are considered likely to be associated with background concentrations within the underlying natural strata and / or the regional groundwater quality of the local area.
- Exceedances of Environmental Quality Standards in the Alluvium are noted within boreholes in close proximity to the River Wensum. These

are thought to be related to surrounding widespread leaching of soils. Additionally, groundwater levels in these boreholes were shallow and, on some occasions, flooded completely to ground level which would suggest that surface water may have impacted groundwater in the underlying Alluvium.

- Regarding Drinking Water Standards exceedances, there are no groundwater abstractions utilised for the abstraction of drinking water located within the vicinity of the Site Boundary.

Future Baseline

13.5.70 Should the study area remain in its current use, it is considered unlikely to present a notable risk to the identified sensitive receptors. As the study area currently predominantly comprises agricultural land and given that gross widespread contamination is not anticipated to be present within soils or underlying groundwater, the degree of risk to the identified receptors is unlikely to increase if the surrounding land use remains unchanged.

13.5.71 Based upon current climate change scenario projections under RCP8.5 there are not anticipated to be significant changes to groundwater levels or sea level rise from the present baseline.

13.5.72 There are no identified committed developments within the Red Line Boundary which are likely to affect the future baseline in relation to Geology and Soils.

13.5.73 Overall, the future baseline is not anticipated to differ significantly from the current baseline in the immediate future.

13.6 Sensitive Receptors

13.6.1 The following sensitive receptors have been assessed:

Table 13-18 Resource/receptor value (sensitivity)

Resource / Receptor	Resource Value (Sensitivity)	Justification
Construction Workers	High	Significant earthworks will be required as part of the Proposed Scheme which may bring construction workers into contact with potentially contaminated soils and groundwater. However, no significant contamination of soils or groundwater was identified during the site investigations undertaken to date. Furthermore, it is assumed that the construction phase will be undertaken in accordance with all relevant legislation, guidance and best practice, which will mitigate occupational risks to construction workers during works on the Proposed Scheme.
Third Party Neighbours	Low	Third party neighbours may be within influence of the areas of construction (> 250 m distant) which include significant disturbance of ground during construction. Additionally, it is assumed that the construction phase will be undertaken in accordance with all relevant legislation, guidance and best practice, which will mitigate risks to third party neighbours during construction of the Proposed Scheme.
Former Attlebridge Landfill	Low	The former Attlebridge Landfill is subject to a 250m safeguarding consultation zone. The northern extent of the Proposed Scheme falls within this zone.

Resource / Receptor	Resource Value (Sensitivity)	Justification
Controlled Water: Alluvium (Secondary A Aquifer)	Medium	The Alluvium is a Secondary A Aquifer and is associated with the River Wensum. The entirety of the 1km Study Area is located within a groundwater SPZ 3 (total catchment).
Controlled Water: Head Deposits (Secondary B Aquifer)	Medium	The Head Deposits are a Secondary B Aquifer. The entirety of the Site Boundary is located within a groundwater SPZ 3 (total catchment).
Controlled Water: River Terrace Deposits (Secondary A Aquifer)	Medium	The River Terrace Deposits are Secondary A Aquifers. The entirety of the Site Boundary is located within a groundwater SPZ 3 (total catchment).
Controlled Water: Sheringham Cliffs Formation (Secondary A Aquifer)	Medium	The Sheringham Cliffs Formation is a Secondary A Aquifer. The entirety of the Site Boundary is located within a groundwater SPZ 3 (total catchment).

Resource / Receptor	Resource Value (Sensitivity)	Justification
Controlled Water: Happisburgh Glacigenic Formation (Secondary Undifferentiated Aquifer)	Medium	The Happisburgh Glacigenic Formation is a Secondary Undifferentiated Aquifer. The entirety of the Site Boundary is located within a groundwater SPZ 3 (total catchment).
Controlled Water: White Chalk Subgroup (Principal Aquifer)	Very High	The White Chalk Subgroup is a Principal Aquifer and provides baseflow to the River Wensum which is a Chalk fed river and SAC. The entirety of the Site Boundary is located within a groundwater SPZ 3 (total catchment).
Controlled Water: River Wensum	Very High	The River Wensum is a Main River as defined by the EA.
Controlled Water: Multiple unnamed water features	Medium	There are a number of unnamed water features associated with the River Wensum floodplain and other minor watercourses within the 1km study area. These drain into the River Wensum which is a Main River as defined by the EA.

Resource / Receptor	Resource Value (Sensitivity)	Justification
Groundwater Dependant Terrestrial Ecosystems (GWDTE)	High	The River Wensum SAC lies within the 1km Study Area. The River Wensum SAC is not specifically classified as a GWDTE, however the river and associated fens are dependent on groundwater and therefore are considered to be GWDTE.
Below ground services and building structures	Low	This includes buildings, services and foundations, as well as proposed structures within the 250m study area. Utility services, except for potable water supply pipes, are not adversely affected by contamination.
Agricultural Soils (Biomass production)	Low-Very High	Areas of Grade 2 agricultural soils are present within the southern extents of the Soils Study Area (Very High), Grade 3a (High) and Grade 3b (Moderate) are present across the majority of the Soils Study Area and Grade 4 agricultural soils are present within the River Wensum Floodplain only associated with the flood risk.
Soil Function (Ecological habitat, soil carbon, soil hydrology and mineral resource)	Medium-High	Peaty organic soils (although not peat) have been identified associated with the River Wensum, including the River Wensum SAC (High). The remainder of soils are considered to be Medium due to the likely soil hydrology value.

13.7 Assessment of Potential Effects, Mitigation and Residual Effects

13.7.1 The following forms of Embedded Mitigation have been considered within the Construction Phase assessment.

13.7.2 The Proposed Scheme would introduce hardstanding at the road surface which would provide betterment and reduce infiltration of rainwater into the ground where it is present and therefore limit the mobilisation of potential contaminants of concern.

Construction Phase

Table 13-19 Assessment of potential effects on construction workers health from pre-existing contamination within the underlying soils/groundwater during construction activities

Description	**Potential effects on construction workers health from pre-existing contamination within the underlying soils/groundwater during construction activities.**
Sensitive receptor	Construction workers
Potential effects	Potential sources of contamination have been identified as part of the Interpretative Desk Study Report including on-site Made Ground/infilled ground, use of soil additives associated with agricultural land use and off-site infilled workings and a landfill. Ground investigations have been completed within areas of permanent land take covered by the Proposed Scheme (provided in **Appendix 13.3** (Document Reference 3.13.03). No significant contamination of soils or groundwater was identified during the site investigations undertaken to date. Ground investigations have not yet been undertaken within areas of temporary land use (such as for construction compounds). Should contaminants be present within soil and groundwater within these areas, construction workers may be exposed to contaminants that may be present in the Made Ground, or that are present in the ground (i.e., after migrating from off-site sources) during any earthworks or activities that involves the disturbance of Made Ground. These works may facilitate exposure to asbestos or other by the inhalation of dusts, gases or vapours, dermal contact with soil and groundwater and ingestion of soil and dust. Construction workers may also be exposed to previously unidentified contamination within areas of permanent land take during construction (as described above). Any adverse health effects from direct and/or indirect exposure/impact to the potentially contaminated soil and groundwater could persist over a short (temporary) to long-term (permanent) period depending on the nature of the contaminants encountered. In addition, construction workers could be exposed to UXO during ground investigations, excavation or piling activities. If a device were activated it could have both short- and long-term as well as temporary and permanent effects. However, a Detailed UXO Assessment has reported that the Proposed Scheme is generally at Low risk from UXO, however some areas (as shown on Plate 13.1) have been determined to be Medium risk. The sensitivity of construction workers is high and the magnitude of impact, prior to mitigation, is moderate. Therefore, there is likely to be a direct, temporary/permanent, cumulative, short to long-term moderate or large adverse effect (**significant**) on construction workers prior to the implementation of additional mitigation measures.

Description	**Potential effects on construction workers health from pre-existing contamination within the underlying soils/groundwater during construction activities.**
Additional mitigation	The following measures should be incorporated within a Construction Environmental Management Plan (CEMP): • Construction workers would be required to wear PPE such as gloves and face masks (where appropriate) to prevent dermal contact and inhalation or ingestion. Appropriate site hygiene facilities will be put in place and the presence of contaminants and the associated risks will be explained to ground workers before they begin work. • Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne where it may affect construction workers. Wheel washing of site vehicles will be implemented to prevent tracking of contaminated material off-site. • Fuel storage on-site to be carried out under best practice i.e., integrally bunded containers. Plant refuelling to be carried out using best practice techniques and any spills to be controlled with spill kit. • Dust suppression measures (e.g., damping down) will be implemented to minimise the potential for dust generation. • Within areas determined to be Medium risk within the Detailed UXO Risk Assessment Peer Review, a UXO Engineer should be retained on-site in order to detect for excavations and earthworks and safely manage UXO items, prior to and during construction. Ground investigation and risk assessment will be carried out within areas of temporary land take to identify potential contaminant linkages prior to commencement of the Construction Phase in line with British Standards (BS) 10175 (2011+A2:2017), Investigation of Potentially Contaminated Sites - Code of Practice **(Ref 13.42)** and Land Contamination Risk Management (LCRM) **(Ref 13.29)** guidance. Should the ground investigation identify contaminant linkages then a Remediation Strategy will be produced, outlining the mitigation measures required in order to manage any residual risks to human health receptors. Any recommendations specific to the construction phase should be followed. Any remediation undertaken would be validated and report on within a Verification Report to provide confidence that it has been undertaken with the agreed strategy. There is a possibility that previously unidentified contamination may be encountered within soils and groundwater during construction works. A watching brief for ground contamination will be maintained. If visually contaminated or odorous material is encountered during the works, the assistance of a suitably qualified and experienced person (a geo-environmental engineer) will be sought.
Residual effects and monitoring	The sensitivity of construction workers is high, and the magnitude of effect, following mitigation, is negligible. Therefore, there is likely to be an indirect/direct, temporary/permanent, short to long-term slight adverse residual effect on construction workers (**not significant**) following the implementation of mitigation measures.

Table 13.20 Assessment of potential effects on adjacent third party neighbours from potential contamination within the underlying soils during construction activities

Description	**Potential effects on adjacent third-party neighbours from potential contamination within the underlying soils during construction activities.**
Sensitive receptor	Third-party neighbours
Potential effects	Excavation of potentially contaminated soils could pose a health risk to third-party neighbours in the immediate vicinity of the Proposed Scheme through inhalation of contaminated dusts and particulate matter generated by excavation/ activities that involve the disturbance of Made Ground. Third-party neighbours may be exposed to contaminants that are present in the Made Ground, or that are present in the ground (i.e., after migrating from off-site sources) during any earthworks or activities that involves the disturbance of Made Ground. No significant contamination of soils or groundwater was identified during the site investigations undertaken to date. Ground investigations have not yet been undertaken within areas of temporary land use (such as for construction compounds). Should contaminants be present within soil and groundwater within these areas third-party neighbours may also be exposed to contaminants that may be present in the Made Ground, or that are present in the ground (i.e., after migrating from off-site sources) during any earthworks or activities that involves the disturbance of Made Ground. These works may facilitate exposure to asbestos or other by the inhalation of dusts, gases or vapours, dermal contact with soil and groundwater and ingestion of soil and dust. The impact to third-party neighbours would be dependent on the type and nature of contamination (if present) and the characteristics of receptor and duration of exposure (i.e., vulnerable child or elderly person). Exposure/impact to third-party neighbours would mostly likely be indirect (i.e., inhalation of windblown dusts in ambient air). If these receptors are exposed to contaminants above threshold concentrations, there is potential for both short (temporary) and long-term (permanent) health problems to arise dependent on the nature of the contaminants encountered. The sensitivity of third-party neighbours is considered to be medium, and the magnitude of impact, prior to mitigation is moderate. Therefore, there is likely to be indirect, temporary/permanent, short to long-term moderate adverse effects (**significant**) on third-party neighbours prior to the implementation of mitigation measures.

Description	**Potential effects on adjacent third-party neighbours from potential contamination within the underlying soils during construction activities.**
Additional mitigation	The following measures should be incorporated within a Construction Environmental Management Plan (CEMP): • Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne where it may affect third-party neighbours. Wheel washing of site vehicles will be implemented to prevent tracking of contaminated material off-site. • Fuel storage on-site to be carried out under best practice i.e., integrally bunded containers. Plant refuelling to be carried out using best practice techniques and any spills to be controlled with spill kit. • Dust suppression measures (e.g., damping down) will be implemented to minimise the potential for dust generation. • Within areas determined to be Medium risk within the Detailed UXO Risk Assessment Peer Review, a UXO Engineer should be retained on-site in order to detect for excavations and earthworks and safely manage UXO items, prior to and during construction. Ground investigation and risk assessment will be carried out within areas of temporary land take to identify potential contaminant linkages prior to commencement of the Construction Phase in line with British Standards (BS) 10175 (2011+A2:2017) Investigation of Potentially Contaminated Sites - Code of Practice **(Ref 13.42)** and Land Contamination Risk Management (LCRM) **(Ref 13.29)** guidance. Should the ground investigation identify contaminant linkages then a Remediation Strategy will be produced, outlining the mitigation measures required in order to manage any residual risks to human health receptors. Any recommendations specific to the construction phase should be followed. Any remediation undertaken would be validated and report on within a Verification Report to provide confidence that it has been undertaken with the agreed strategy. There is a possibility that previously unidentified contamination may be encountered within soils and groundwater during construction works. A watching brief for ground contamination will be maintained. If visually contaminated or odorous material is encountered during the works, the assistance of a suitably qualified and experienced person (a geo-environmental engineer) will be sought.
Residual effects and monitoring	The sensitivity of third-party neighbours is medium, and the magnitude of impact, following mitigation, is minor. Therefore, there is likely to be indirect, temporary/permanent, short to long term slight adverse residual effects on third-party neighbours (**not significant**) following the implementation of mitigation measures.

Table 13-21 Assessment of potential effects on the former Attlebridge landfill during construction activities

Description	**Potential effects on the former Attlebridge Landfill during construction activities.**
Sensitive receptor	Former Attlebridge Landfill
Potential effects	The Proposed Scheme encroaches upon the south-east area of the 250m safeguarding consultation zone for the former Attlebridge Landfill. The construction of the Proposed Scheme within this area comprises the tying in of the Proposed Scheme within the existing roundabout of the A1067 and upgrade works to the A1067. These works will not require piling or significant earthworks and therefore are not considered likely to affect the aftercare plan of the former Attlebridge Landfill. Additionally, ground investigations undertaken within this area have not identified any contamination indicative of impact from the landfill onto the Proposed Scheme. The sensitivity of the former Attlebridge Landfill is low and the magnitude of impact, prior to mitigation, is negligible. Therefore, there is likely to be an indirect/direct, temporary/permanent, short to long-term neutral or slight adverse effect (**not significant**) on the former Attlebridge Landfill prior to the implementation of additional mitigation measures.
Additional mitigation	No mitigation is considered to be required.
Residual effects and monitoring	The sensitivity of the former Attlebridge Landfill is low, and the magnitude of effect, remains unchanged as negligible. Therefore, there is likely to be an indirect/direct, temporary/permanent, short to long-term neutral or slight adverse residual effect on the former Attlebridge Landfill (**not significant**) as no mitigation is considered to be required.

Table 13-22 Assessment of potential effects on Controlled Waters and GWDTE during construction activities

Description	**Potential effects on Controlled Waters and GWDTE during construction activities.**
Sensitive receptor	Controlled Waters which include Secondary A Aquifers (Alluvium, River Terrace Deposits, Sheringham Cliffs Formation), Secondary B Aquifer (Head Deposits), Secondary Undifferentiated Aquifer (Happisburgh Glacigenic Formation), Principal Aquifer (White Chalk Subgroup), Surface Waters including the River Wensum and multiple unnamed water features and GWDTE (River Wensum SAC).
Potential effects	Although the majority of the land use within the 1km Study Area is agricultural, a number of potentially contaminated site uses have been identified including the former Attlebridge Landfill located to the north-west of the A1067 to the north of the Site Boundary. Ground investigation works undertaken to date have not reported significant contaminant impact within groundwater underlying the Proposed Scheme which are considered to require remedial intervention. Ground investigations have not yet been undertaken within areas of temporary land use (such as for construction compounds). Should contaminants be present within soil and groundwater within these areas Controlled Waters may also be exposed to contaminants that may be present in the Made Ground, or that are present in the ground (i.e., after migrating from off-site sources) during any earthworks or activities that involves the disturbance of Made Ground. During construction, the exposure and/or displacement of soils and Made Ground via the removal of surface cover (e.g., hardstanding and/or turf) has the potential to mobilise soil-bound contaminants/sediment via soil erosion/overland flow migration pathways, resulting in impacts on GWDTE, surface water features, and lead to an increase in the vertical leaching of contaminants from soils to underlying groundwater. Piling techniques will be required in the construction of the viaduct and approach road and embankment. Piles are anticipated to be up to 50m in length with a diameter of 2.1m. Piling may create preferential/direct exposure contaminant migration pathways (i.e., connect contaminants (if present) within shallow soils to underlying aquifers, including White Chalk Subgroup Principal Aquifer). Impacts to underlying groundwater may have an indirect adverse effect on the quality of local licensed and unlicensed abstractions which could be undergoing potable use. The use of machinery and plant associated with construction activities (including the establishment of a site construction compound and storage of chemicals or fuels) could give rise to localised, indirect contaminant impact to surface and groundwater receptors through accidental fuel / oil and chemical spills and leaks. Based on the principles of natural attenuation (i.e., eventual weakening of contaminants caused by various processes e.g., dilution) all effects on Controlled Waters receptors would be temporary but would vary in duration depending on the nature of the contaminants released. Based on the current/future resource potential, baseline water quality information and understanding of the hydraulic regime, the sensitivity of Controlled Waters is considered to be high and the magnitude of impact, prior to mitigation is moderate. Therefore, there is likely to be to be direct/indirect, temporary, short to long term moderate or large adverse impacts on Controlled Waters and GWDTE receptors (**significant**) prior to the implementation of mitigation measures.

Description	Potential effects on Controlled Waters and GWDTE during construction activities.
Additional mitigation	During the construction phase, risks posed to Controlled Waters from potential sources of contamination will be accounted for within a Construction Environmental Management Plan (CEMP). Within this document a number of mitigation measures protective of Controlled Waters should be detailed such as the specification of on-site fuel storage (i.e., integrally bunded containers). Ground investigation and risk assessment will be carried out within areas of temporary land take to identify potential contaminant linkages prior to commencement of the Construction Phase in line with British Standards (BS) 10175 (2011+A2:2017), Investigation of Potentially Contaminated Sites - Code of Practice **(Ref 13.42)**and Land Contamination Risk Management (LCRM) guidance **(Ref 13.29)**. Should the ground investigation identify contaminant linkages then a Remediation Strategy will be produced, outlining the mitigation measures required in order to manage any residual risks to human health receptors. Any recommendations specific to the construction phase should be followed. Any remediation undertaken would be validated and report on within a Verification Report to provide confidence that it has been undertaken with the agreed strategy. There is a possibility that previously unidentified contamination may be encountered within soils and groundwater during construction works. A watching brief for ground contamination will be maintained. If visually contaminated or odorous material is encountered during the works, the assistance of a suitably qualified and experienced person (a geo-environmental engineer) will be sought. If Site-won material is to be reused across the Proposed Scheme, this should be undertaken in accordance with a Materials Management Plan (MMP), in accordance with CL:AIRE Definition of Waste: Code of Practice. This will ensure the chemical suitability of the placement of soils at depth (i.e., potentially in contact with underlying groundwater) or within close proximity to sensitive receptors (i.e., embankments associated with surface water features that fall within the Site Boundary). A Piling Risk Assessment would be produced to outline measures to protect the underlying aquifers during construction and mitigate risk of creating preferential pathways for potential contamination.
Residual effects and monitoring	The sensitivity of Controlled Waters and GWDTE receptors is high, and the magnitude of impact, following mitigation, is negligible. Therefore, there is likely to be to be direct/indirect, temporary, short to long term slight adverse effects on Controlled Waters and GWDTE receptors (**not significant**) following the implementation of mitigation measures.

Table 13-23 Assessment of potential effects associated with construction activities impacting below ground services and building structures

Description	**Potential effects associated with construction activities impacting below ground services and building structures.**
Sensitive receptor	Below ground services and building structures.
Potential effects	Buildings, services and foundations, as well as proposed structures within the 250m study area are not considered likely to be adversely affected by contamination during construction. Potable water supply pipes have the potential to be impacted by contamination, however no significant contamination of soils or groundwater was identified during the site investigations undertaken to date. The sensitivity of below ground services and building structures is low and the magnitude of impact, prior to mitigation, is negligible. Therefore, there is likely to be a direct, temporary/permanent, short-term neutral or slight adverse effect (**not significant**) on below ground services and building structures prior to the implementation of additional mitigation measures.
Additional mitigation	No mitigation is considered to be required.
Residual effects and monitoring	The sensitivity of below ground services and building structures is low, and the magnitude of effect remains unchanged as a direct, temporary/permanent, short-term neutral or slight adverse effect (**not significant**) as no mitigation is considered to be required.

Table 13-24 Assessment of potential effects associated with construction activities impacting agricultural soils

Description	**Potential effects associated with construction activities impacting agricultural soils.**
Sensitive receptor	Agricultural soils
Potential effects	A detailed ALC and Soils Resources Survey has been undertaken for the majority of land within the Site Boundary. Pre-1988 mapping has been reviewed for all other areas within the Site Boundary and the wider Red Line Boundary. The detailed ALC survey determined that 11.25ha of ALC Grade 2 (BMV) soils are present across the south of the Proposed Scheme. 18.23ha of ALC Grade 3a (BMV) and 95.54ha of Grade 3b (non-BMV) are present across the majority of the remainder of the Proposed Scheme. 5.91ha of ALC Grade 4 soils (non-BMV) are present in the area of the proposed viaduct over the River Wensum. Non-agricultural land covers 29.91ha of the Proposed Scheme. For areas within the Soils Study Area not subject to a detailed ALC survey, based upon pre-1988 mapping it was determined 9.34ha of ALC Grade 2 (BMV), 70.96ha of ALC Grade 3 and 30.74 ha Grade 4 (non-BMV) are present. Based upon pre-1988 mapping alone it is not possible to determine the proportion of ALC Grade 3 which is ALC Grade 3a (BMV) or ALC Grade 3b (non-BMV). An additional area of 19.96ha of ALC Grade 3 land is proposed for Woodland Enhancement, however is considered to be non-agricultural in nature as it is already used as woodland. Should all ALC Grade 3 land be conservatively considered to be ALC Grade 3a (BMV) then the total area of BMV land (ALC Grade 2 and 3a) required for the Proposed Scheme is approximate 89.82ha. Of this total 26.52ha is for temporary land take and 63.3ha is permanent land take. Construction activities associated with the Proposed Scheme will result in adversely impacting underlying agricultural soils by the compaction, sealing and loss of potentially productive or valuable agricultural land. However, approximately 33.24ha of BMV will be used for Environmental Enhancement and Essential Mitigation Areas (**Essential Environmental Mitigation Plan** (Document Reference: 2.11.00)) with some agricultural activities (i.e grazing) to continue. In addition, the process to select these areas for these uses has involved consultation with landowners to choose the preferred areas. The impact to soils beneath the footprint of the Proposed Scheme will be permanent (i.e., will be covered in hardstanding). Impacts to soils within areas of temporary construction works (i.e., within satellite compounds, haul roads or access tracks) may only be temporary and could be subject to a period of restoration. The sensitivity of agricultural soils range between low to very high and the magnitude of impact, prior to mitigation, is major. Therefore, there is likely to be a direct, temporary/permanent, long-term very large adverse effect (**significant**) on agricultural soils prior to the implementation of additional mitigation measures.

Description	**Potential effects associated with construction activities impacting agricultural soils.**
Additional mitigation	For areas of Grade 3 agricultural land within the Red Line Boundary which have not been subject to a Detailed ALC Survey, a Soil Resource Survey will be undertaken to inform how they may best be managed, protected or re-used. This survey will also determine the proportion of Grade 3a (BMV) and Grade 3b (non-BMV) for this land. Site-won material is to be reused across the Proposed Scheme, this will be undertaken in accordance with a Materials Management Plan (MMP), in accordance with CL:AIRE Definition of Waste: Code of Practice. For areas of temporary land take, a Soil Management Plan would be produced prior to any enabling or construction works commencing. This will describe best practice methods to reduce impacts to soil during handling and would be informed by site-specific soil and climatological data. This would include details on stripping methods, stockpiling requirements, appropriate management (including weather conditions during handling, seeding of stockpiles, stockpile heights etc) and reinstatement. Works should also be undertaken in compliance with Defra's Construction Code of Practice **(Ref 13.43)**. Highly organic soils, including loamy peat and peaty loam, were present in the area surveyed. Although not as sensitive as peat these will be less resilient than more minerogenic soils and therefore will require careful management. The organic soils present will also have a high carbon content. Although the materials have not met the definition of peat, conservatively a Peat Carbon Assessment is provided in **Chapter 15: Climate Greenhouse Gases** (Document Reference: 3.15.00). In addition, best practice construction methods would be included in the CEMP to provide methods of minimising the loss or reduction of soil functions (i.e., dust mitigation measures).
Residual effects and monitoring	The sensitivity of underlying agricultural soil resources is low-very high, and the magnitude of effect, following mitigation, is major due to the permanent loss of BMV being >20ha. Therefore, there is likely to be a direct, temporary/permanent, long-term very large adverse residual effect on soil resources (**significant**) following the implementation of mitigation measures.

Table 13-25 Assessment of potential effects associated with construction activities impacting soil resource and function

Description	**Potential effects associated with construction activities impacting soil resource and function.**
Sensitive receptor	Soil function
Potential effects	*River Wensum SAC* Peaty soils (although not peat) with high organic matter contents are present associated with the River Wensum. As a worst case scenario, construction activities associated with the Proposed Scheme may require removal of a limited volume of these peaty soils, which would either be reused within landscaping areas of the Proposed Scheme or disposed of off-site. Once the peaty soils were removed a geotechnically suitable granular material would be placed on which a piling platform could be constructed to support construction of the viaduct. Removal of the peaty soils will likely require dewatering activities which could impact a wider area beyond the Site Boundary within the River Wensum SAC. Further assessment relating to dewatering is included within **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00). Compaction caused by soil handling activities and construction traffic can cause significantly reduced soil infiltration rates. This may result in an adverse impact of the underlying soil function in supporting water flows and flood management associated with the River Wensum floodplain by the removal, compaction, and sealing of these soils. The disturbance and/or removal of the peaty soils would also increase the carbon losses and reduce the carbon storage of these soils. Excavation of these peaty soils could also impact the water quality of the groundwater and River Wensum through mobilisation of nutrients or pollutants. *Remainder of the Proposed Scheme* Across the remainder of the main road alignment, the impact to soil function (in particular the soils' function in supporting water flows and flood risk management within the catchment) beneath the footprint of the main road alignment will be permanent (i.e., will be covered in hardstanding). Impacts to soils within areas of temporary construction works (i.e., within satellite compounds, haul roads or access tracks) may only be temporary and could be subject to a period of restoration. Impacts to soils within Environmental Enhancement and Essential Mitigation Areas and WFD Enhancement Areas during construction will be temporary (i.e. during construction works to create these areas) and will improve over time once the areas are created. Overall, the sensitivity of soil function is medium-high and the magnitude of impact, prior to mitigation, is moderate. Therefore, there is likely to be a direct, temporary/permanent, long-term moderate or large adverse effect (**significant**) on soil function prior to the implementation of additional mitigation measures.

Description	Potential effects associated with construction activities impacting soil resource and function.
Additional mitigation	If Site-won material is to be reused across the Proposed Scheme, this should be undertaken in accordance with a Materials Management Plan (MMP), in accordance with CL:AIRE Definition of Waste: Code of Practice. A Soil Management Plan would be produced prior to any enabling or construction works commencing. This will describe best practice methods to reduce impacts to soil during handling and would be informed by site-specific soil and climatological data. This would include details on stripping methods, stockpiling requirements, appropriate management (including weather conditions during handling, seeding of stockpiles, stockpile heights etc) and reinstatement. Works should also be undertaken in compliance with Defra's Construction Code of Practice **(Ref 13.43)**. Measures outlined within Annex E and Appendix K of the IEMA A New Perspective on Land and Soil in Environmental Impact Assessment guidance **(Ref 13.25)** should also be followed by the Contractor. For the ancillary roads, the 'floating haulage route' method should be used for the movement of vehicles used for peaty soils handling. Other low-impact measures should be used for handling peaty soils, such as the use of low ground pressure vehicles and other equipment. Although the peaty soils are not considered to meet the definition of peat, conservatively a Peat Management Plan should be produced. The construction of the viaduct has the potential to require dewatering. This activity will require a dewatering licence which will include consideration of control measures prior to construction. Further information regarding potential dewatering is included within **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00). In addition, best practice construction methods would be included in the CEMP to provide methods of minimising the loss or reduction of soil functions.
Residual effects and monitoring	The sensitivity of underlying soil function is medium-high, and the magnitude of effect, following mitigation, is negligible. Therefore, there is likely to be a direct, temporary/permanent, long-term slight adverse residual effect on soil function (**not significant**) following the implementation of mitigation measures.

Assessment against Future Baseline

In-combination Climate Change Impacts

13.7.3 In-combination Climate Change impact assessment considers the extent to which Climate Change may alter the effects which have already been identified within this ES chapter. The assessment has been informed by the information within paragraphs 13.5.16 to 13.5.19 and by professional judgement as there is inherent uncertainty in Climate Change projections.

13.7.4 The in-combination assessment of Climate Change impacts in relation to ground conditions is detailed in below.

Table 13-26 Climate change impacts – Geology and soils

Climate Hazard	Receptor	Likely Impact(s)	Mitigation Required
An increase in winter precipitation and a decrease in summer precipitation	Controlled Waters	Potential future increases or decreases in precipitation could affect groundwater (and consequentially surface water) quality underlying the Proposed Scheme as potential contaminants currently above the groundwater table could be mobilised.	Long term monitoring of the groundwater table of up to a year to assess current seasonal fluctuations in groundwater level has been undertaken. Results are provided within **Appendix 13.3** (Document Reference 3.13.03) and will be incorporated into the design.

13.8 Opportunities for Environmental Enhancement

13.8.1 The National Planning Policy Framework (NPPF) requires the Proposed Scheme to be 'suitable for use' in relation to ground contamination. Therefore, should contamination be present, the development of the Proposed Scheme would provide a beneficial effect through remediation works, if required. Beyond this it is not considered that there are further opportunities for environmental

enhancements in relation to ground conditions for the Proposed Scheme.

13.9 Cumulative Effects

13.9.1 Cumulative effects for Geology and Soils have been assessed within **Chapter 20: Cumulative Effects** (Document Reference: 3.20.00).

13.10 Difficulties and Uncertainties

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

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

13.11 Summary

13.11.1 **Table 13-27** provides a summary of the findings of the assessment.

Table 13-27 Summary of Geology and Soils effects

Receptor	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Construction Phase Construction workers (human health receptors)	Potential effects on construction workers health from pre-existing contamination within the underlying soils/groundwater during construction activities.	Implementation of measures outlined within a CEMP. Further ground investigation within Temporary Works Areas. Within areas determined to be Medium risk within the Detailed UXO Risk Assessment Peer Review, a UXO Engineer should be retained on-site in order to detect for excavations and earthworks and safely manage UXO items, prior to and during construction. Any construction phase/human health specific recommendations included within a remediation strategy (if required) should be followed. Validation of any remediation. Watching brief for unexpected contamination should be maintained during construction.	**Slight Adverse (not significant)** I/D, P/T & ST – LT	Mitigation measures included within the CEMP should be subject to monitoring and updating (if required). Further in-situ UXO monitoring (e.g., magnetometer surveys) during earthworks may be required.

Receptor	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Construction Phase Third-party neighbours (human health receptors)	Potential effects on adjacent third-party neighbours from potential contamination within the underlying soils during construction activities.	Implementation of measures outlined within a CEMP. Further ground investigation within Temporary Works Areas. Within areas determined to be Medium risk within the Detailed UXO Risk Assessment Peer Review, a UXO Engineer should be retained on-site in order to detect for excavations and earthworks and safely manage UXO items, prior to and during construction. Any construction phase/human health specific recommendations included within a remediation strategy (if required) should be followed. Validation of any remediation. Watching brief for unexpected contamination should be maintained during construction.	**Slight Adverse (not significant)** I, P/T & ST – LT	Mitigation measures included within the MMP should be subject to monitoring and updating (if required).
Construction Phase Former Attlebridge Landfill	Potential effects on the former Attlebridge Landfill during construction activities.	Not applicable	**Slight Adverse (not significant)** I/D, T & ST – LT	Not applicable

Receptor	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Construction Phase Underlying groundwater and nearby surface water features (Controlled Waters Receptors)	Potential effects on Controlled Waters and GWDTE during construction activities.	Implementation of measures outlined within a CEMP. Further ground investigation within Temporary Works Areas. Any construction phase/Controlled Waters specific recommendations included within a remediation strategy (if required) should be followed. A piling risk assessment should be undertaken. Validation of any remediation. Any Site-won material to be reused across the Proposed Scheme should be undertaken in accordance with an MMP.	**Slight Adverse (not significant)** I/D, T & ST – LT	Not applicable
Construction Phase Below ground services and building structures	Potential effects associated with construction activities impacting below ground services and building structures.	Not applicable	**Slight Adverse (not significant)** I/D, T & ST	Not applicable

Receptor	Potential Effects	Additional Mitigation	Residual Effects	Monitoring
Construction Phase Agricultural soils	Potential effects associated with construction activities impacting agricultural soils.	Detailed ALC Survey within areas of ALC Grade 3 as shown on Figure 13.2. Any recommendations specific to the management of soils during the construction phase should be followed. Any Site-won material to be reused across the Proposed Scheme should be undertaken in accordance with an MMP. A Soil Management Plan should be produced prior to any enabling or construction works commencing.	**Very Large Adverse (significant)** D, P/T & LT	Mitigation measures detailed within the CEMP should be subject to monitoring and updating (if required).
Soil Function	Potential effects associated with construction activities impacting soil resource and function.	If Site-won material is to be reused across the Proposed Scheme, this should be undertaken in accordance with an MMP. A Soil Management Plan should be produced prior to any enabling or construction works commencing. Production of a Peat Management Plan.	**Moderate or Large adverse** (**significant**) D, P/T & LT	Not applicable

Key to table: P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term

13.12 References

- **Ref 13.1** HMSO (1990) Part IIA of the Environmental Protection Act, 1990.
- **Ref 13.2** HMSO (2012) The Contaminated Land (England) (Amendment) Regulations.
- **Ref 13.3** Department for Environment, Food and Rural Affairs, Contaminated Land Statutory Guidance April 2012.
- **Ref 13.4** HMSO (2003) The Water Environment (Water Framework Directive) (England & Wales) Regulations (2000/60/EC), 2017.
- **Ref 13.5** HMSO (2006) Groundwater Directive 2006/118/EC.
- **Ref 13.6** HMSO (2015) Construction (Design & Management) Regulations.
- **Ref 13.7** HMSO (2021) Environment Act 2021
- **Ref 13.8** HMSO (2006) Dangerous Substances Directive (Amendment) Regulations, 2006.
- **Ref 13.9** HMSO (2012) The Control of Asbestos Regulations
- **Ref 13.10** HMSO (2012) The Contaminated Land (England) (Amendment) Regulations.
- **Ref 13.11** HMSO (2009) Environmental Damage and Liability (Prevention and Remediation) Regulations, 2009.
- **Ref 13.12** HMSO (1991) Water Resources Act
- **Ref 13.13** The Town and Country Planning (Development Management Procedure) (England) Order 2015.
- **Ref 13.14** Department for Transport, National Policy Statement for National Networks 2014.

- **Ref 13.15** Ministry of Housing, Communities and Local Government 2019 (updated July 2021), National Planning Policy Framework.
- **Ref 13.16** Department for Environment, Food and Rural Affairs, A Green Future: Our 25 Year Plan to improve the Environment, 2018.
- **Ref 13.17** Broadland District Council (2015), Development Management DPD.
- **Ref 13.18** Norfolk County Council (2015), Norfolk County Council's Environmental Policy
- **Ref 13.19** Greater Norwich Development Partnership (published March 2011, amended January 2014), Joint Core Strategy for Broadland, Norwich and South Norfolk
- **Ref 13.20** Broadland and South Norfolk District Council, Broadland District Council and South Norfolk District Council Contaminated Land Strategy (2019 – 2024)
- **Ref 13.21** Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government June 2014 (updated July 2019), Guidance, Land affected by contamination.
- **Ref 13.22** Highways Agency (2019) Design Manual for Roads and Bridges (DMRB) Sustainability and Environment Appraisal LA104 Environmental Assessment and Monitoring (formerly HA205/08, HD48/08, IAN125/15, and IAN 133/10)
- **Ref 13.23** DMRB, (October 2019) LA 109 Geology and Soils (formerly DMRB Volume 11, Section 3, Part 11 & Part 6), Revision 0

- **Ref 13.24** DMRB, (March 2020), LA 113 Road Drainage and the Water Environment (formerly HD45/09), Rev 1
- **Ref 13.25** Institute of Environmental Management & Assessment (IEMA), (February 2022) A New Perspective on Land and Soil in Environmental Impact Assessment
- **Ref 13.26** Ministry of Housing, Communities & Local Government, (March 2014), Planning Practice Guidance Minerals.
- **Ref 13.27** Ministry of Housing, Communities & Local Government, (June 2014, updated July 2019), Planning Practice Guidance Land affected by contamination.
- **Ref 13.28** Department for Environment, Food and Rural Affairs (April 2012) 'Contaminated Land Statutory Guidance'.
- **Ref 13.29** Environment Agency, (2020), Land Contamination: Risk Management (LC: RM)
- **Ref 13.30** Contaminated Land: Applications in Real Environments (CL:AIRE), (2011), The Definition of Waste: Development Industry Code of Practice (DoW: CoP)
- **Ref 13.31** Rudland, D. Lancefield, R. Mayell, P (2001) CIRIA C552 Contaminated Land Risk Assessment: A guide to good practice
- **Ref 13.32** Society of Brownfield Risk Assessment, Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change, Version 1, August 2022
- **Ref 13.33** Model Procedures for the Management of Contaminated Land, Contaminated Land Report 11 (CLR11), Environment Agency, September 2004.

- **Ref 13.34** Guidance for the Safe Development of Housing on Land Affected by Contamination: R&D Publication 66
- **Ref 13.35** https://eip.ceh.ac.uk/hydrology/eflag/ (last accessed 01/02/2023)
- **Ref 13.36** Norfolk County Council (October 2013), Norfolk Minerals and Waste Development Framework Mineral Site Specific Allocations Development Plan Document (October 2013).
- **Ref 13.37** Natural England (2012). Technical Information Note 049 - Agricultural Land Classification: protecting the best and most versatile agricultural land, Second Edition.
- **Ref 13.38** MagicMap (last accessed 01/02/2023)
- **Ref 13.39** Ministry of Agriculture, Fisheries and Food (MAFF). Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land. October 1988.
- **Ref 13.40** Detailed Unexploded Ordnance Risk Assessment, Norwich Western Link Road Option C, MACC International Ltd, dated 7th August 2019 (Ref. 6021)
- **Ref 13.41** Detailed UXO Risk Assessment – Peer Review, Norwich Western Link, Fellows International Ltd, dated 2nd March 2022 (NCCT41793-FEL-VGN-FSC-RA-GI-0001)
- **Ref 13.42** British Standards (BS) 10175 (2011+A2:2017), Investigation of Potentially Contaminated Sites - Code of Practice
- **Ref 13.43** Defra, Code of practice for the sustainable use of soils on construction sites, 2011 (last updated 14 June 2018