



# **West Winch Housing Access Road**

## **Chapter 12: Geology and Soils**

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## Contents

Glossary of Abbreviations and Defined Terms .....	4
Abbreviations .....	4
Glossary .....	4
1 Introduction .....	5
1.2 Legislative Framework, Policy and Guidance .....	6
1.3 Consultation, Scope, Methodology and Significance Criteria .....	9
1.4 Baseline Conditions .....	22
1.5 Design and Embedded Best Practice Mitigation Measures .....	35
1.6 Assessment of Likely Significant Effects and additional mitigation .....	38
1.7 Opportunities for Environmental Enhancement .....	46
1.8 Difficulties and Uncertainties .....	46
1.9 Summary .....	47
1.10 References .....	50

## Tables

Table 1-1 Summary of consultation undertaken .....	10
Table 1-2 Elements scoped out of the assessment .....	12
Table 1-3 Receptor Sensitivity Criteria .....	18
Table 1-4 Impact Magnitude Criteria .....	20
Table 1-5 Impact magnitude Criteria for Agricultural Land .....	21
Table 1-6 Scale of Effect Criteria .....	22
Table 1-7 Summary of Geology .....	24
Table 1-8 On-Site Sources of Contamination .....	29
Table 1-9 Off-Site Sources of Contamination .....	32
Table 1-10 Assessment of likely significant effect and additional mitigation during construction - human health .....	38
Table 1-11 Assessment of likely significant effect and additional mitigation during construction – controlled waters .....	40
Table 1-12 Assessment of likely significant effect and additional mitigation during construction – below ground services .....	42
Table 1-13 Assessment of likely significant effect and additional mitigation during construction – agricultural .....	43



Table 1-14 Assessment of likely significant effect and additional mitigation during construction – human health.....	44
Table 1-15 Assessment of likely significant effect and additional mitigation during construction – controlled waters .....	45
Table 1-16 Summary of Ground Conditions and Contamination effects.....	48



## Glossary of Abbreviations and Defined Terms

### Abbreviations

Item	Description
BCO	Building Control Officer
CLO	Contaminated Land Officer
DQRA	Detailed Quantitative Risk Assessment
EA	Environment Agency
GQRA	Generic Quantitative Risk Assessment
MRA	Minerals Risk Assessment
MSA	Minerals Safeguarding Area
PRA	Preliminary Risk Assessment
PWS	Public Water Supply
SPZ	Source Protection Zone
UXO	Unexploded Ordnance

### Glossary

Item	Description
Aquifer	A water-bearing permeable rock layer.
Source Protection Zone	Provides addition protection to safeguard drinking water quality through constraining and proximity of an activity that may impact upon drinking water.
Best Most Versatile Land	Land defined as grade 1, 2 or 3a of the Agricultural Land Classification. This land is considered the most flexible, productive and efficient and is most capable of delivering crops for food and non-food uses.



## 1 Introduction

1.1.1 This chapter of the Environmental Statement (ES) reports on the likely contamination, minerals resource and agricultural land effects to arise from the construction stage and the operation stage of the Proposed Scheme.

1.1.2 The Proposed Scheme is located to the southeast of Kings Lynn between the A47 (northern extent) and the A10 (southern extent), crossing a number of agricultural land parcels and will provide a link between the A47, to the north, and A10, to the south.

1.1.3 This chapter (and its associated appendices) is intended to be read as part of the wider ES, with particular reference to **Chapters 11 - Water Environment** and **13 – Materials and Waste** along with the following appendices:

- **Appendix 12.1:** WSP West Winch Housing Access Road, Preliminary Risk Assessment (PRA), dated May 2023
- **Appendix 12.2:** West Winch Housing Access Road Ground Conditions Appraisal (REF 70039893), dated February 2021
- **Appendix 12.3:** West Winch Housing Access Road, Minerals Resource Assessment (REF 70039893-MRA) dated July 2021
- **Appendix 12.4:** West Winch Housing Access Road, Agricultural Land Classification and Soils Resource dated October 2023.

1.1.4 This chapter assesses the following potentially significant effects:

- The potential for disturbance of existing contaminated land associated with the construction and operational phases of the Proposed Scheme.
- The potential that construction could establish pathways between pollutants and receptors associated with the construction phase of the Proposed Scheme.



- Effects on users/adjacent users from the mobilisation of contaminants associated with the construction and operational phases of the Proposed Scheme.
- Effects on controlled waters (from the mobilisation of contaminants) associated with the construction and operational phases of the Proposed Scheme.
- Effects on buried infrastructure (including buried services and foundations) associated with the construction and operational phases of the Proposed Scheme.
- Effects on mineral resource to avoid unnecessary sterilisation of mineral resources and encourages prior extraction where practicable and viable before non-mineral development takes place to monitor loss and /or contamination.
- Effects on the loss of agricultural land to be replaced by built development and open space.

## 1.2 Legislative Framework, Policy and Guidance

### Legislative Framework

1.2.1 The applicable legislative framework is summarised as follows :International Legislation:

- Water Framework Directive (WFD) (European Council, 2000); (Ref. 12.1)
- Environmental Quality Standards (EQS) (European Council , 2008)(Ref. 12.2); and
- Priority Substances Directive (European Council, 2013). (Ref. 12.3)



National Legislation and Policy:

- Part 2A of the Environmental Protection Act 1990 (EPA) (Secretary of State, 1990) as inserted by S.57 of The Environment Act (Secretary of State, 1995); (Ref.12.4)
- The Contaminated Land (England) Regulations (Secretary of State, 2012) (Ref.12.5);
- Water Framework Directive Directions (Secretary of State, 2017) (Ref 12.6);
- The Water Supply (Water Quality) Regulations (Secretary of State, 2016) (Ref 12.7)
- Water Resources Act 1991 (Ref 12.8); and
- National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities) 2023 (Ref.12.9)

Policy

1.2.2 The following relevant policy document titles are listed below and further outlined within the Planning Statement:

**Local Policy relevant to West Winch and North Runcton Parish can be found in the neighbourhood plan** (Borough Council of King's Lynn & West Norfolk, 2017) (Ref 12.10)

- Policy WA06: Protecting agricultural land and soils; and
- Policy GA04: Design of 'relief road'.

**Local Policy relevant to King's Lynn & West Norfolk can be found in the Local Development Framework – Core Strategy** (King's Lynn & West Norfolk Borough Council, 2011) (Ref 12.11)

- Policy CS08: Sustainable Development; and
- Policy CS12: Environmental Assets.



**Local Policy relevant to West Winch can be found in the Site Allocations and Development Management Policies** (Norfolk County Council, 2016) (Ref **12.12**)

- Policy E2: West Winch Growth Area Strategic Policy.

**Local Policy relevant to West Winch can be found in the Norfolk Minerals and Waste Development Framework, Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010 – 2026** (Norfolk County Council, 2011) (Ref **12.13**);

- Policy CS16 – Safeguarding mineral and waste sites and mineral resources

#### Guidance

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

#### **National Guidance and Industry Standards:**

- BS10175 Investigation of Potentially Contaminated Sites Code of Practice (British Standards Institute, 2011) (Ref **12.14**);
- Land Contamination: Risk Management (LCRM) (Environment Agency , 2020) (Ref **12.15**);
- Guidance on the legal definition of contaminated land (Department for Environment, Food and Rural Affairs (DEFRA), 2008) (Ref **12.16**);
- Guiding Principles on Land Contamination (Environment Agency, 2010) (Ref **12.17**);
- Human Health Toxicological Assessment of Contaminants in Soil (Environment Agency, 2008) (Ref **12.18**);
- Updated Technical Background to the Contaminated Land Exposure Assessment (CLEA) Model (Environment Agency , 2008) (Ref **12.19**);





- C665: Assessing risks posed by hazardous ground gases to buildings (Construction Industry Research and Information Association , 2007) (Ref **12.20**);
- Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health and Volatile Contaminates in Groundwater (The Society of Brownfield Risk Assessment (SOBRA), 2017) (Ref **12.21**).
- EA's approach to groundwater protection (Environment Agency, 2018) (Ref **12.22**);
- Anti-Pollution Works Regulations (Secretary of State, 1999) (Ref **12.23**);
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (UK Water Industry Research (UKWIR), 2010) (Ref **12.24**);
- Special Digest 1. 3rd Edition (including February 2017 amendments), Concrete in aggressive ground (Building Research Establishment (BRE), 2005) (Ref **12.25**);
- Waste Classification Guidance on the calcification and assessment of waste (Environment Agency, 2015) (Ref **12.26**).
- National Quality Mark Scheme for Land Contamination Management (CL:AIRE, 2020) (Ref **12.27**).

### **1.3 Consultation, Scope, Methodology and Significance Criteria**

#### Consultation Undertaken to Date

- 1.3.1 Table 1-1 provides a summary of the consultation activities undertaken in support of the preparation of this assessment.



**Table 1-1 Summary of consultation undertaken**

<b>Body / organisation</b>	<b>Individual / stat body / organisation</b>	<b>Meeting dates and other forms of consultation</b>	<b>Summary of outcome of discussions</b>
Borough Council of King's Lynn and West Norfolk	Contaminated Land Officer (CLO)	Contacted on the 3 <sup>rd</sup> May 2019, and on 12 <sup>th</sup> May 2023	<p>Setch tip and Setchy landfill, approximately 350m to the south of the site.</p> <p>There are no records of PWS within 500m.</p> <p>Two part B processes within 500m (Sainsburys Petrol station and West Winch service station)</p> <p>The site has not been prioritised for inspection under Part 2A, is not known to be contaminated or undergone remediation.</p> <p>A site approximately 200m to the east has been inspection under Part 2A following a major fire. (Manor Farm).</p>
Borough Council of King's Lynn and West Norfolk	Building Control Officer (BCO)	Contacted on 12 <sup>th</sup> May 2023	No response received.



<b>Body / organisation</b>	<b>Individual / stat body / organisation</b>	<b>Meeting dates and other forms of consultation</b>	<b>Summary of outcome of discussions</b>
Environment Agency	Environment Agency	Response provided on 14 <sup>th</sup> June 2019 with additional update received on 13 <sup>th</sup> June 2023.	Response provided information on potential sources of contamination to include landfills and pollution incidents.  One abstraction license within 500m.  Confirmation provided that there are no records of contaminated land as defined under Part 2A of the Environmental Protection Act 1990 within the boundary required for the Proposed Scheme or within 500m of the boundary.



Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Norfolk County Council	Minerals and Waste Policy Team	Response provided 4 <sup>th</sup> February 2022	The Minerals Resource Assessment (MRA) <b>(Appendix 12.3)</b> provides sufficient information, and it will not be necessary to submit an additional Mineral Safeguarding Assessment (MSA). The MRA concluded that the majority of the site is not viable for extraction and that the development overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted.

Scope of the Assessment

- 1.3.2 The scope of this assessment has been established through an ongoing scoping process with the Scoping Opinion undertaken in accordance with Regulation 15(1) of the EIA Regulations 2017 (**Ref 12.28**). Further information can be found in **Chapter 5: Approach to EIA**.
- 1.3.3 The elements shown in **Table 1-2** are not considered to give rise to likely significant effects as a result of the Proposed Scheme and have therefore not been considered within this assessment:

**Table 1-2 Elements scoped out of the assessment**

Element scoped out	Justification
Potential effect on slope stability	No significant slopes were noted during the walkover



Elements scoped into the assessment

### **Construction Phase**

1.3.4 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 impact on human health receptors including construction workers, current on-site users, and neighbouring site users due to the potential for disturbance of contaminated land;
- Potential impact on controlled water receptors due to the mobilisation of contaminants;
- Potential impacts on buried infrastructure;
- Potential impact on agricultural land; and
- Potential impact on geology – Mineral Safeguarding Areas.

### **Operational Phase**

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

- Potential impact on health of maintenance workers, future site users and neighbouring site users; and
- Potential impact on controlled waters receptors.

Extent of the Study Area

1.3.6 The extent of the study area for the assessment of ground conditions encompasses information on current and historical anthropogenic activities for all options in the following areas:

- Within the Site for human health, controlled water receptors, minerals and agricultural land;
- Within 250m to 500m of the Site for human health receptors; and



- Within 500m of the Site for controlled waters receptors.

The extent of this zone has been developed using professional judgement on the basis that contamination migration beyond this distance is likely to be negligible.

Site boundaries are shown within Appendix A of **Appendix 12.1**.

Method of Baseline Data Collation

### **Desk Study**

1.3.7 The aim of the Desk Study (WSP West Winch Housing Access Road, Preliminary Risk Assessment (PRA), dated May 2023) (Appendix 12.1) was to highlight the key contamination constraints / ground risks associated with the Site. The PRA includes a review of previous reports and provides a Conceptual Site Model that has been used to inform the assessment. The PRA has obtained data from the below sources which gives an understanding of the likely baseline conditions that have been established:

- British Geological Survey (BGS) Map Sheet 145 with part of 129 Solid and Drift – King’s Lynn and the Wash (1:50,000, 1978)
- BGS Map Sheet 159 Solid and Drift – Wisbech (1:50,000, 1995)
- Natural England Multi-Agency Geographic Information for the Countryside (MAGIC); and
- Agricultural Land Classification Map, Eastern Region (ALC008)

### **Site Surveys**

1.3.8 WSP completed a site visit during May 2019 to gain an overview of the site and identify any potential sources of contamination.

1.3.9 A ground investigation was undertaken by WSP in areas of the Proposed Scheme. A total of 11 no. groundwater monitoring visits were completed at the site, within the window sample exploratory holes between August and December 2020. Groundwater samples were collected from the window sample locations on two occasions (August and November 2020).



## Assessment Methodology

1.3.10 The methodology for the assessment of potential soil contamination at the Site reflects the requirements of Part 2A of the Environmental Protection Act (Secretary of State, 1990).

1.3.11 The basis of the EIA with respect to contamination would be a qualitative assessment, using information provided within existing baseline studies and applying professional judgment to consider the significance of potential risk, the latter of which will be based on the likelihood of a complete pollutant linkage being created as a result of the Proposed Scheme (the source-pathway-receptor methodology, hereafter referred to as the 'conceptual site model'; CSM).

1.3.12 For transparency, the approach adopted in applying professional judgement would be confirmed by clearly setting out the sensitivity of receptor criteria, magnitude of impact criteria and scale of effect matrix.

1.3.13 The following tiered risk-based approach will be followed, underpinned by a CSM:

- Tier 1 - Development of the specific CSM;
- Tier 2 - Assessment of site investigation results against Soil Guideline Values (SGVs) or Generic Assessment Criteria (GAC) where available; and
- Tier 3 - Assessment of site investigation results against Site Specific Assessment Criteria (SSAC) as derived by Detailed Quantitative Risk Assessment (DQRA).

1.3.14 In accordance with the LCRM (Environment Agency , 2020) document, the effects associated with contamination have been assessed by means of the source/contaminant-pathway-receptor methodology, which can be summarised as follows:



- Contaminant: contamination that has the potential to cause unacceptable adverse impacts to a receptor. This may comprise chemical, biological, or physical agents.
- Receptor: a target that may be affected by contamination; examples include human occupants or users of the site, water resources or structures; and
- Pathway: a route whereby a contaminant may come into contact with a receptor; examples include ingestion of contaminated soil and leaching of contaminants from soil into water resources.

1.3.15 The sensitivity of receptors and outline methodology for assessing significance would be based on relevant guidance including Design Manual for Road and Bridges (DMRB) LA 109 (Standards For Highways, 2019) (Ref 12.29).

1.3.16 For contamination to present a potential effect, a contaminant linkage must first be established using the Conceptual Site Model approach. The likelihood must be demonstrated that there is an identifiable source of contamination (be it an on-site or off-site source), sensitive receptors and a viable pathway through which the former may affect the latter.

### **Construction Stage**

1.3.17 The assessment of potential impacts and likely effects has, therefore, comprised the following approach:

- Identification and establishment of the sensitivity of receptors on the basis of their use, proximity to the site, existing quality, or resource value;
- Consideration of potential source-pathway-receptor linkages;
- Evaluation of the magnitude of potential impacts from potential contamination as a result of the introduction of the Proposed Scheme;





- Consideration of embedded mitigation measures integral to the Proposed Scheme proposals;
- Classification of the significance of likely effects;
- Identification of additional mitigation measures to eliminate or reduce residual effects, where considered necessary; and
- Re-assessment to conclude the significance of residual effects.

### **Operational Stage**

1.3.18 The construction stage methodology has been applied to the identification of likely significant effects during the operational stage.

### **Significance Criteria**

1.3.19 The significance level attributed to each effect has been assessed based on the sensitivity/value of the affected receptor(s) and the magnitude of change arising from the Proposed Scheme, as well as a number of other factors that are outlined in more detail in Chapter 5: Approach to EIA. The sensitivity of the affected receptor is assessed on a scale of high, medium, low and negligible, and the magnitude of change is assessed on a scale of major, moderate, minor, negligible and no change, as set out in Chapter 5: Approach to EIA.

1.3.20 The sensitivity of receptors has been classified as low, medium, or high, in accordance with the criteria set out in Table 1.3.

**Table 1-3 Receptor Sensitivity Criteria**

<b>Sensitivity</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>	<b>Negligible</b>
<b>Human health (construction / maintenance workers and site users and adjacent site users)</b>	<ul style="list-style-type: none"> <li>Residential properties with private gardens</li> <li>Schools/care homes/ hospitals /playing fields</li> <li>Construction/ maintenance workers</li> </ul>	<ul style="list-style-type: none"> <li>Residential properties without plant uptake</li> <li>retail and business parks (public and workplaces)</li> <li>Public open spaces</li> </ul>	<ul style="list-style-type: none"> <li>Commercial/ industrial properties, highways, and rail.</li> </ul>	Not Applicable
<b>Controlled waters (groundwater and surface water)</b>	<ul style="list-style-type: none"> <li>EA defined principal aquifers</li> <li>EA defined secondary A aquifers overlying principal aquifers</li> <li>EA groundwater SPZ 1</li> <li>Surface water bodies of high quality</li> </ul>	<ul style="list-style-type: none"> <li>EA defined secondary A and B aquifers (where not overlying principal aquifers)</li> <li>EA groundwater SPZ 2 and 3</li> <li>Surface water bodies of moderate quality</li> </ul>	<ul style="list-style-type: none"> <li>EA defined unproductive strata and secondary undifferentiated aquifers</li> <li>Minor local drainage network</li> </ul>	Not Applicable
<b>Buried structures (services and buried concrete)</b>	<ul style="list-style-type: none"> <li>Residential property, related infrastructure, and services to be utilised by people.</li> </ul>	<ul style="list-style-type: none"> <li>Potable water supply pipes and buried concrete.</li> <li>Commercial or industrial related infrastructure, where services are not required to be utilised by people.</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure with no requirement for service.</li> </ul>	Not Applicable
<b>Agricultural land</b>	<ul style="list-style-type: none"> <li>Soils directly supporting a designated site e.g. SAC, SPA, Ramsar</li> <li>Soils directly supporting a designated UK site e.g. SSSI</li> <li>Agricultural Land Classification (ALC grade 1, 2 and Grade 3a)</li> </ul>	<ul style="list-style-type: none"> <li>Soils supporting non-statutory designated sites e.g. local nature reserves</li> <li>ALC Grade 3b</li> </ul>	<ul style="list-style-type: none"> <li>Soils supporting non-designated notable or priority habitats</li> <li>ALC Grade 4 or 5</li> </ul>	Not Applicable

<b>Sensitivity</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>	<b>Negligible</b>
<b>Geological</b>	<ul style="list-style-type: none"> <li>• SSSIs</li> <li>• Major strategic mineral resource areas</li> <li>• Strategic underground storage space</li> <li>• Solution features</li> <li>• Regionally Important Geological Sites ('RIGS')</li> </ul>	<ul style="list-style-type: none"> <li>• Local geological sites and important mineral resource areas or Mineral Safeguarding Areas ('MSA')</li> </ul>	<ul style="list-style-type: none"> <li>• Mineral Areas of Search/Consultation Areas ('MCA')</li> </ul>	Not Applicable



1.3.21 The magnitude of change has been classified as minor, moderate or major, in accordance with the criteria set out in Table 1.4.

**Table 1-4 Impact Magnitude Criteria**

Magnitude of Impact	Definition
<b>Major</b>	<p>Change in soil quality or ground gas regime for a large area (&gt;20ha) of land, sufficient to alter land use (e.g. remediation of 20ha of industrial land sufficient to enable mixed residential / commercial use).</p> <p>Change in groundwater conditions sufficient to change aquifer use (e.g. contamination that prevents abstraction for potable supplies, or remediation of impacted aquifer sufficient to enable potable abstractions).</p> <p>Generation of large volumes of non-inert waste materials for disposal off-site to landfill.</p>
<b>Moderate</b>	<p>Change in soil quality or ground gas regime for a moderate area of land (&lt;20ha) to a degree sufficient to alter land use in localised portions of the Site or to a degree requiring a change in management / Mitigation Measures for Site use.</p> <p>Change in groundwater conditions that may be sufficient to change local groundwater regime and potential aquifer uses (e.g. localised contaminant impact, localised change in groundwater levels).</p>
<b>Minor</b>	<p>Measurable but relatively small scale change in an area of contaminated land or ground gas regime, but insufficient to alter end land use.</p> <p>Change in groundwater conditions that are insufficient to change status or potential use of the water body.</p>
<b>Negligible</b>	<p>Very limited mass of contamination mobilised – just detectable.</p> <p>Very limited change in area of agricultural land.</p> <p>Very limited barely discernible change to groundwater regime.</p>

1.3.22 The impact magnitude criteria for agricultural land as a result of the Proposed Scheme are detailed within **Table 1.5**. The assessment of magnitude is based on professional judgement as well as guidance within Roads and Bridges (DRMB) LA 109 (Standards For Highways, 2019) (**Ref: 12.29**).



**Table 1-5 Impact magnitude Criteria for Agricultural Land**

Significance criteria	Definition
<b>Major adverse</b>	Permanent loss or degradation of over 20ha of best and most versatile land (BMVL), or entire regional resources of BMVL (ALC Grades 1, 2, 3a)
<b>Moderate adverse</b>	Permanent loss or degradation of 5-20ha of BMVL, or large proportion of regional resource of BMVL.
<b>Minor adverse</b>	Permanent loss or degradation of <5ha of BMVL, or small proportion of regional resource of BMVL.
<b>Negligible</b>	Permanent loss or degradation of non-BMVL.
<b>No change</b>	No observable impact in either direction, positive or negative.

Effect Significance

1.3.23 The following terms have been used to define the significance of the effects identified and apply to both beneficial and adverse effects:

- **Large effect:** effects at this level are likely to be material in the decision-making process;
- **Moderate effect:** effects at this level can be considered to be material decision-making factors;
- **Slight effect:** effects at this level are not material in the decision-making process; and
- **Neutral effect:** no effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.



**Table 1-6 Scale of Effect Criteria**

<b>Scale of Effect Criteria</b>	<b>High (Sensitivity of Receptor)</b>	<b>Medium (Sensitivity of Receptor)</b>	<b>Low (Sensitivity of Receptor)</b>	<b>Negligible (Sensitivity of Receptor)</b>
<b>Major (Magnitude of Change)</b>	Large	Moderate or Large	Slight or Moderate	Slight
<b>Moderate (Magnitude of Change)</b>	Moderate or Large	Moderate	Slight	Neutral or Slight
<b>Minor (Magnitude of Change)</b>	Slight or Moderate	Slight	Neutral or Slight	Neutral or Slight
<b>Negligible (Magnitude of Change)</b>	Neutral	Neutral	Neutral	Neutral

1.3.24 As set out in **Chapter 5: Approach to EIA**, effects that are classified as **moderate or above** are considered to be **significant**. Effects classified as below **moderate** are considered to be **not significant**.

#### **1.4 Baseline Conditions**

1.4.1 The baseline conditions are the environmental conditions against which the potential environmental effects of the Proposed Scheme are assessed. The conditions refer to the present time and with no significant change predicted during the interim period before development works are programmed to commence. The data used for the baseline assessment for the ES is dated from February to May 2023.

1.4.2 The baseline conditions are summarised below with further details provided in the West Winch Housing Access Road Ground Conditions Appraisal (REF 70039893), dated February 2021; West Winch Housing Access Road, Mineral Resource Assessment (REF 70039893-MRA) dated July 2021; and West



Winch Housing Access Road, Preliminary Risk Assessment (PRA) (REF 70100518-PRA) dated May 2023.

#### Historical Land Use

- 1.4.3 Information taken from the West Winch Housing Access Road PRA suggests that the majority of the Proposed Scheme has predominantly served as agricultural land since its initial mapping in 1884.
- 1.4.4 Roadways within the Proposed Scheme include A10, A47, Rectory Lane and Chequers Lane. A historical railway (Midland and Great Northern joint railway) (dismantled from 1979) was located to the south of the Hardwick interchange. From 1964 residential properties have been developed in the settlements of West Winch and North Runcton, to the west and east of the Proposed Scheme.
- 1.4.5 From 1979 industrial uses include factories, depots, warehouses, superstores, trading estates and industrial estates have been developed to the north west, of the Hardwick Interchange.

#### Geology and Hydrogeology

- 1.4.6 The BGS Map Sheet 145 with part of 129 Solid and Drift – King’s Lynn and the Wash (1:50,000, 1978); and Sheet 159 Solid and Drift – Wisbech (1:50,000, 1995) have been reviewed along with WSP Ground Appraisal Report. The underlying geology is presented in **Table 1.7** together with EA aquifer designations for the relevant geological units.



**Table 1-7 Summary of Geology**

<b>Strata</b>	<b>EA Aquifer Designation</b>	<b>Thickness (m) (Refer to Note 1)</b>	<b>Location within Proposed Scheme</b>
Topsoil	N/A	0.30 – 0.65	Across the Proposed Scheme (Refer to Note 1)
Alluvium	Secondary (A)	1.00	Encountered in one location (TP217) in the north. Not noted on BGS mapping for the Proposed Scheme.
Raised Beach Deposits	Secondary (A)	N/A	Not encountered during the GI BGS mapping indicates this is located in the north of the Proposed Scheme.
Tottenhill Gravel Member	Secondary (A) Aquifer	0.40 – 1.85	Central and Southern section's (Refer to Note 1) BGS mapping indicates this is within the southern area of the Proposed Scheme.
Head	Secondary Undifferentiated	1.50	Encountered in one location (WS106) located in the south-west of the Proposed Scheme. BGS mapping indicates this is potentially located west area of the Hardwick Interchange.
Lowestoft Formation	Secondary Undifferentiated	0.40 – 4.80	Central and Southern section's (Refer to Note 1) BGS mapping indicates this is also potentially located in the northern area of the Proposed Scheme.





<b>Strata</b>	<b>EA Aquifer Designation</b>	<b>Thickness (m) (Refer to Note 1)</b>	<b>Location within Proposed Scheme</b>
Sandringham Sand Formation (Leziate Member)	Principal Aquifer	N/A	Not encountered during the GI. BGS mapping indicates this is located in the northern and central sections of the Proposed Scheme.
Sandringham Sand Formation (Mintlyn Member)	Principal Aquifer	0.50 – 4.60 (Not proven in the central section)	Northern, Central and southern sections
Sandringham Sand Formation (Roxham and Runcton Member)	Principal Aquifer	0.20 – 2.60	Northern, central and southern sections
Kimmeridge Clay Formation	Unproductive Strata	0.40 – 3.55 (not proven)	Northern, and Southern sections. Potential to be encountered in the central sections.

Note 1 - Information taken from WSP Ground Investigation Appraisal Report, February 2021



## Hydrology

- 1.4.7 There are numerous unnamed ditches, field drains and bodies of waters (ponds or pooling surface water) observed on OS mapping on the Proposed Scheme route or within 500m of the Proposed Scheme route in all directions. During the WSP Ecology Team Survey carried out in 2018, two ponds were identified as being within the vicinity of the route of the Proposed Scheme, however these were noted as being dry.
- 1.4.8 The Pierpoint Drain (Middleton Stop Drain) is located approximately 300m north-east of the northernmost point of the Proposed Scheme (Hardwick Interchange) at its closest point. It flows from east to west to the north of the Proposed Scheme towards the River Nar. The River Nar is the nearest named river that is classified as a Main River and is located approximately 2.2km west of the Proposed Scheme and approximately 1.15km south of the southernmost point of the Proposed Scheme, therefore outside of the study area for assessment.
- 1.4.9 The Proposed Scheme is designated as Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)). The area adjacent to the north, east and west of the Hardwick Interchange is located within Flood Zone 2 and 3 but does benefit from flood defences.
- 1.4.10 One surface water abstraction is recorded within 500m of the Proposed Scheme. The abstraction is located approximately 300m north-east (Sheet Map E / ID 48) from the Pierpoint Drain. The abstraction relates to Hardwick Farm Partnership for spray irrigation. The permit start date is recorded as April 2018 with no supplied end date.

## Preliminary Hydrogeological Model

- 1.4.11 Groundwater is likely to flow westerly towards the River Nar, however this is likely to be variable. Based on the BGS borehole logs groundwater levels are likely to be shallow at approximately 1.0 m bgl to 12.0 m bgl, depending on the location along the Proposed Scheme.



1.4.12 During the ground investigation in 2020 shallow groundwater was encountered within predominately granular strata, such as the Tottenhill Sands and Gravels, Mintyln Member and the Roxham and Runcton Beds as well as within the Lowestoft Formation. Groundwater levels encountered ranged between 0.10m bgl to 3.41m bgl.

1.4.13 The Proposed Scheme is not located within an EA groundwater Source Protection Zone.

1.4.14 No groundwater abstractions are located within 500m of the Proposed Scheme.

Unexploded Ordnance Risk (UXO)

1.4.15 Publicly available bomb risk mapping supplied by Zetica indicates that the Proposed Scheme has a low risk of UXO.

Safeguarded Mineral Resources

1.4.16 WSP completed a MRA and identified that the Proposed Scheme lies within a MSA within the Norfolk Minerals and Waste Development Framework (Ref 12.13). A review of the Ground Conditions Appraisal concluded that the majority of the site is not viable for extraction and that the development overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted.

1.4.17 Correspondence from Norfolk County Council confirms that the MRA provides sufficient information, and it will not be necessary to submit an additional MSA in this case. Based on this information minerals, Norfolk County Council has agreed that this can be scoped out and not be taken any further as part of this assessment.

Agricultural Land

1.4.18 The Proposed Scheme is located within agricultural land, classified as Grades 2 and 3, as highlighted within the Environmental Constraints Plan (Appendix B). Government guidance<sup>73</sup> limits development on Grades 2 and 3a farmland, known as 'Best and Most Versatile' (BMV) land.



1.4.19 An Agricultural Land Classification and Soil Resource assessment has been undertaken (Appendix 12.4) that states that 23.9 hectares of the Proposed Scheme is located within Grade 2 land, 23 hectares within Grade 3a land and 1.8 hectares within Grade 3b land.

#### Landfilling

1.4.20 No landfills have been identified to lie within the footprint of the Proposed Scheme.

1.4.21 Two historical landfills have been identified within 500m of the Proposed Scheme. One BGS recorded landfill site Setch Tip, was noted approximately 290m south and one local authority landfill site located 410m south of the Proposed Scheme. One registered landfill (ref: 35/4/2221) operated by S George was noted approximately 365m south of the Proposed Scheme.

1.4.22 Four areas of unknown filled ground (pit, quarry, etc.) have been recorded within 500m of the Proposed Scheme and 13no. areas of unknown filled ground (pond marsh, river, stream, dock, etc.) with distances ranging from 206m to 443m.

1.4.23 No waste transfer registered waste treatment or disposal sites are recorded within 500m of the Proposed Scheme.

#### Sensitive Land Uses

1.4.24 The Proposed Scheme is not located within any statutory or non-statutory designated sites. There are no statutory or non-statutory designated areas within 500m of the Proposed Scheme.

1.4.25 The entire Proposed Scheme area is located within a Nitrate Vulnerable Zone.

#### Potential Contaminative Source

##### **Existing On site**

1.4.26 The existing on-site contaminative sources identified in Table 1.8 are predominantly associated with the historical use of the site. Comments have been made on the likelihood of hazard realisation based on the information available.

**Table 1-8 On-Site Sources of Contamination**

Location	Source(s)	Comment on Hazard Realisation
Entire Proposed Scheme	Current and historical roads including A10, A147, Rectory Lane and Chequers Lane:  Metals, hydrocarbons, polycyclic aromatic hydrocarbons (PAH).	<ul style="list-style-type: none"> <li>• Possibility of migration of contaminants via fugitive dust or surface flow from any road spills.</li> <li>• No Made Ground or asbestos was encountered during the investigation in 2020.</li> <li>• No exceedances were identified within the soils to the Public open space GAC or most conservative land use (residential with plant uptake) in the 2020 investigation.</li> <li>• Minor Exceedances in metal (copper, nickel and zinc) concentrations were noted within groundwater sampled from six locations across the site. Minor Exceedances in PAHs were also noted in groundwater from one location,</li> <li>• Due to the limited nature of the ground investigation it is not possible to confirm that these exceedances are due to onsite sources however likely to be representative of regional background concentrations. To date groundwater exceedances do not correspond with the analysed soil samples</li> <li>• Contamination identified in the shallow groundwater has the potential to migrate laterally across the site and offsite.</li> </ul>
Entire Proposed Scheme	Current and historical agricultural use including a sheepwash (Hardwick Interchange):  Pesticides, pathogens	<ul style="list-style-type: none"> <li>• It is unknown what chemicals the farmers use or have used. Inorganic pesticides (e.g. containing arsenic) could have been used.</li> <li>• No exceedances were identified within the soils to the Public open space GAC or most conservative land use (residential with plant uptake) in the 2020 investigation.</li> </ul>

Location	Source(s)	Comment on Hazard Realisation
South area of Hardwick Interchange	<p>Historical railway:</p> <p>A wide range of potential contaminants, depending on the source of material, but may include asbestos, metals, cyanide, hydrocarbons, PAH, phenols, volatile organic compounds (VOCs), and semi volatile organic compounds (SVOCs).</p>	<ul style="list-style-type: none"> <li>• No Made Ground or asbestos was encountered during the investigation in 2020.</li> <li>• No exceedances were identified within the soils to the Public open space GAC or most conservative land use (residential with plant uptake) in the 2020 investigation.</li> <li>• Minor Exceedances in metal (copper, nickel and zinc) concentrations were noted within groundwater sampled from six locations across the site.</li> <li>• Minor Exceedances in PAHs were also noted in groundwater from one location. Due to the limited nature of the ground investigation it is not possible to confirm that these exceedances are due to onsite sources however likely to be representative of regional background concentrations. To date groundwater exceedances do not correspond with the analysed soil samples</li> <li>• Contamination identified in the shallow groundwater has the potential to migrate laterally across the site and offsite.</li> </ul>
Northern section	<p>Inactive clay pit :</p> <p>A wide range of potential contaminants, depending on the source of material, but may include asbestos, metals, cyanide, hydrocarbons, PAH, phenols, VOCs, SVOCs and ground gases.</p>	<ul style="list-style-type: none"> <li>• No Made Ground or asbestos was encountered during the investigation in 2020.</li> <li>• No exceedances were identified within the soils to the Public open space GAC or most conservative land use (residential with plant uptake) in the 2020 investigation.</li> <li>• Minor Exceedances in metal (copper, nickel and zinc) concentrations were noted within groundwater sampled from six locations across the site. Minor Exceedances in PAHs were also noted in groundwater from one location, Due to the limited nature of the ground investigation it is not possible to confirm that these exceedances are due to onsite sources however likely to be representative of regional background concentrations. To date groundwater exceedances do not correspond with the analysed soil samples</li> <li>• Contamination identified in the shallow groundwater has the potential to migrate laterally across the site and offsite.</li> </ul>



### Existing Off site

1.4.27 The existing off-site contaminative sources identified in **Table 1.9** are predominantly associated with the historical use of the site. Comments have been made on the likelihood of hazard realisation based on the information available.

**Table 1-9 Off-Site Sources of Contamination**

Location	Source	Comment on Hazard Realisation
Adjacent to 380m west, south-east and east	Mineral extraction sites: A wide range of potential contaminants, depending on the source of material, but may include asbestos, metals, cyanide, hydrocarbons, phenols, VOCs, SVOCs, polychlorinated biphenyl's (PCBs), PAH and ground gases.	<ul style="list-style-type: none"> <li>• The specific nature and source of fill materials is unknown.</li> <li>• Migration of contamination into underlying Principal, Secondary A and Secondary Undifferentiated Aquifers is possible.</li> <li>• No exceedances were identified within the soils during the ground investigation in 2020.</li> <li>• Minor metal exceedances were identified within the groundwater sampled. These minor exceedances do not correspond with the analysed soil samples.</li> <li>• Shallow groundwater encountered within granular deposits across the site indicates contamination has the potential migrate laterally on or offsite.</li> </ul>
250m and 290m south of the Southern section 206m to 412 west and south of southern section 413m south-west of central section 206m to 443m north-west of Hardwick Interchange	Current and historical landfills and unknown filled ground: A wide range of potential contaminants, depending on the source of material, but may include asbestos, metals, cyanide, hydrocarbons, PAH, phenols, VOCs, SVOCs and ground gases.	<ul style="list-style-type: none"> <li>• The specific nature and source of fill materials is unknown.</li> <li>• The potential for leaching and ground gas generation exists, however the distance from the Proposed Scheme would mitigate any migrating contamination.</li> <li>• No exceedances were identified within the soils during the ground investigation in 2020.</li> <li>• Minor metal exceedances were identified within the groundwater sampled</li> <li>• These minor exceedances do not correspond with the analysed soil samples.</li> <li>• Shallow groundwater encountered within granular deposits across the site indicates contamination has the potential migrate laterally on or offsite.</li> </ul>
0 – 500m surrounding the Proposed Scheme	Current and historical agricultural land uses: Pesticides	<ul style="list-style-type: none"> <li>• It is unknown what chemicals the farmers use or have used. Inorganic pesticides (e.g. containing arsenic) could have been used.</li> </ul>



Location	Source	Comment on Hazard Realisation
0 – 500m surrounding the Proposed Scheme	<p>Surrounding current and historical industrial land uses as outlined in:</p> <p>A wide range of potential contaminants, depending on the source of material, but may include asbestos, metals, cyanide, hydrocarbons, PAH, phenols, VOCs, SVOCs and ground gases</p>	<ul style="list-style-type: none"> <li>• A Category 2 – Significant Incident to controlled waters occurred 305m east of the southern section in 2004 for oil.</li> <li>• Category 2 – Significant incident to Land for firefighting run-off occurred in 2017 255m east of the southern section.</li> <li>• Category 2 – Significant incident to land for household waste occurred in 2002, 385m south of the Southern section.</li> <li>• Due to the distance from the Proposed Scheme, for the pollution incidents, it is unlikely that the Proposed Scheme would have been impacted.</li> <li>• No exceedances were identified within the soils during the ground investigation in 2020.</li> <li>• Minor metal exceedances were identified within the groundwater sampled These minor exceedances do not correspond with the analysed soil samples.</li> <li>• Shallow groundwater encountered within granular deposits across the site indicates contamination has the potential migrate laterally on or offsite.</li> </ul>

Note 1 - information taken from Preliminary Risk Assessment (ref: 70100518-PRA)



## Contamination Pathways

1.4.28 The plausible contaminant pathways for the Proposed Scheme include:

### **Human Health:**

- Dermal contact with contaminated soils and waters;
- Direct Ingestion; of contaminated soils and waters;
- Inhalation of contaminated soils, waters and vapours/gas; and
- Inhalation/ingestion of contaminated soils in airborne dust.

### **Groundwater / geology:**

- Leaching of contaminants from soils;
- Migration of contaminated groundwater, surface water or immiscible contaminants;
- Infiltration of contaminated surface water;
- Dissolution of non-aqueous phase liquid (NAPL) into recharge of groundwater; and
- Lateral migration of contaminated groundwater.

### **Surface water features:**

- Surface water runoff; and,
- Migration of immiscible contaminants.

### **Building Structures:**

- Direct contact with contaminated soils, groundwater or immiscible contaminants; and
- Migration of contaminated groundwater, surface water or immiscible contaminants.



### **Below Ground Services**

- Direct contact with corrosive substances (e.g. sulphates and hydrocarbons) in the soils and shallow groundwater).

### **Agricultural Land**

- Leaching of contaminants;
- Surface water runoff;
- Lateral migration of impacted groundwater; and
- Migration of immiscible contaminants.

Future baseline

1.4.29 If the Proposed Scheme is not implemented, it is anticipated (based on professional judgement) that the baseline ground conditions at the site would remain the same.

## **1.5 Design and Embedded Best Practice Mitigation Measures**

1.5.1 Embedded mitigation measures will be delivered through the implementation of the Construction Environmental Management Plan (CEMP).

1.5.2 The Principal Contractor will be required to implement the measures summarised below to minimise the risk of contamination from construction activities:

- Provision of designated storage facilities with appropriate signage.
- Separate inert, non-hazardous and hazardous waste to include the completion of a waste classification.
- Skips and storage receptacles will be sheeted/lidded and remain closed when waste will not be deposited into them.
- Comply with air quality management measures.
- Provision of spill kits, bunding/drip trays and securing and restricting access to fuel storage containers.



- Correct storage of oil-based materials will comply with the Control of Pollution (Oil Storage) (England) Regulations 2001, as amended, and GPP2: Above ground oil storage tanks. Should fund removal of underground storage tanks, and relevant government guidance must be complied with.
- Comply with the GPP26: safe storage – drums and intermediate bulk containers in relation to commercial storage handling and use.
- Comply with CIRIA C741. Environmental Good Practice on Site (4th Edition) (CIRIA, 2015) (**Ref:12.30**).
- Comply with CIRIA C532. Control of Water Pollution from Construction Sites (CIRIA, 2011). (**Ref:12.31**).
- Comply with Construction (Design and Management) Regulations 2015 (**Ref 12.32**)
- Comply with Health and Safety in construction document HSG150 (**Ref 12.33**)

1.5.3 Additional specific mitigation measures for identified receptors are summarised below and in **Section 12.6**. The measures will be secured by a planning condition, completed by a competent qualified person; and approved by the Local Authority and Environment Agency.

- Targeted ground investigation and Generic Quantitative Risk Assessment (GQRA).
- Remediation works where required to include removal of impacted soils and subsequent validation.
- Concrete design and barrier pipes to withstand any aggressive ground conditions.
- Re-use of chemically suitable site-won and imported soils.



- Implementation of surface water drainage systems to include interceptors for any future fuel chemical spills.
- Provision of cover systems over any contamination that will remain in the ground including proposed hardstanding and a clean cover of topsoil within designated open / landscaping areas.

#### Sensitive Receptors

1.5.4 The following receptors may be impacted by potential sources of contamination within the Proposed scheme. These have been separated into four categories.

#### **Human Health:**

- Current and future users;
- Construction and maintenance workers;
- Off-site non-users in the immediate vicinity including neighbouring residents.

#### **Controlled Waters:**

- Sandringham Sands Formation (Principal Aquifer), Raised Beach Deposits, Alluvium and Tottenhill Gravel Member (Secondary (A) Aquifers) and Head Deposits and Lowestoft Formation (Secondary Undifferentiated Aquifers);
- Surroundings ponds, field drains, ditches and the Pierpoint Drain;

#### **Below Ground Services:**

- Structures, particularly any utilities;
- Potable water supply pipes (if present);

#### **Agricultural Land**

- Best Most Versatile Land (BMVL) – Grades 2 and 3a.



1.6 Assessment of Likely Significant Effects and additional mitigation.

Construction Phase

Table 1-10 Assessment of likely significant effect and additional mitigation during construction - human health

Sensitive Receptor	Human Health – Construction workers Human Health –Site Users and Adjacent Site Users
Likely Significant Effects	<p>All construction works will be completed in accordance with best practice and guidance. Providing the embedded mitigation measures are in place, potential impacts on contamination will be managed and no significant effects on human health receptors (demolition and construction works and adjacent site users) are likely to occur. The sensitivity of human health receptors (Construction workers) is high, and the magnitude of impact after the implementation of embedded mitigation is negligible, resulting in a direct, long term, <b>neutral effect (not significant)</b>.</p> <p>The sensitivity of human health receptor (future site users) due to very limited site exposure is deemed negligible and the magnitude of impact after the implementation of embedded mitigation is negligible, resulting in a <b>neutral effect (not significant)</b>.</p>



<b>Sensitive Receptor</b>	<b>Human Health – Construction workers</b> <b>Human Health –Site Users and Adjacent Site Users</b>
<b>Additional mitigation</b>	<p>The following additional mitigation measures are proposed:</p> <ul style="list-style-type: none"><li>• Completion of a targeted Phase 2 Contaminated Land Ground Investigation and production of a Generic Quantitative Risk Assessment (GQRA) (secured through a planning condition) to assess the ground conditions and extent of any contamination present within the Site. To also confirm the ground gas regime (if required).</li><li>• Any risks from contamination will be managed as part of a Remediation Method Statement and validation report, secured through a planning condition(if required)</li><li>• The reuse of soil within the Site should be governed by the production of a Materials Management Plan (MMP) in which chemical criteria are specified for the import of soils/fill material from off-site and for the reuse of Site won material. The stripping, storage and reuse of subsoil should be carried out in accordance with BS 8061:2013.</li></ul>



**Table 1-11 Assessment of likely significant effect and additional mitigation during construction – controlled waters**

<p><b>Sensitive receptor</b></p>	<p><b>Controlled Waters:</b></p> <p><b>Groundwater – Principal and Secondary (A) Aquifers underlying the Proposed Scheme.</b></p> <p><b>Surface waters – On and off-site features including ponds and small streams bisecting the Proposed Scheme.</b></p>
<p><b>Likely significant effects</b></p>	<p>The occurrence of contamination in regard to controlled waters is deemed unlikely due to previous site use and limited incidences of elevated contaminants within soils and groundwater testing during the ground investigation.</p> <p>All construction works will be completed in accordance with best practice and guidance. This will reduce and control spillages of fuels preventing migration to shallow groundwater or nearby surface water features; and the correct storage of waste materials/soils will reduce the potential for mobilisation of contaminated surface water run-off.</p> <p>The sensitivity of controlled waters receptors (groundwater and surface waters) is High. The magnitude of change, following mitigation is Negligible. Therefore, there is likely to be an in-direct, temporary long-term <b>Neutral</b> residual effect on controlled waters (not significant) following the implementation of mitigation measures.</p>





<b>Sensitive receptor</b>	<b>Controlled Waters:</b> <b>Groundwater – Principal and Secondary (A) Aquifers underlying the Proposed Scheme.</b> <b>Surface waters – On and off-site features including ponds and small streams bisecting the Proposed Scheme.</b>
<b>Additional mitigation</b>	The following mitigation measures are proposed: <ul style="list-style-type: none"><li>• Completion of a Phase 2 Contaminated Land Ground Investigation and production of a GQRA (secured through a planning condition) to assess the ground conditions and extent of any contamination present within the Site. To confirm contamination of underlying groundwater (if present) and on-Site surface waters as well as determining groundwater levels and groundwater flow direction;</li><li>• The ground investigation will determine whether further works for example, remediation and validation are required prior to the commence of construction works; and</li><li>• If the preferred foundation solution includes piles (for any infrastructure such as bridges), a Piling Risk Assessment may be required to confirm the absence of significant risk or mitigation measures required to limit the risk of contamination to deeper water bodies.</li></ul>



**Table 1-12 Assessment of likely significant effect and additional mitigation during construction – below ground services**

<b>Sensitive receptor</b>	<b>Below Ground Services – potable water supply pipes, buried concrete and foundations</b>
<b>Likely significant effects</b>	<p>Concrete design and barrier pipes will be designed to withstand any aggressive ground conditions.</p> <p>The sensitivity of below ground services is Medium, and the magnitude of change, following mitigation, is Negligible. Therefore, there is likely to be a direct, permanent, long-term <b>Neutral</b> residual effect on below ground services (not significant) following the implementation of mitigation measures.</p>
<b>Additional mitigation</b>	<p>Completion of a Phase 2 Contaminated Land Ground Investigation and production of a GQRA (secured through a planning condition) to assess the ground conditions, sulphate concentrations and extent of any contamination present within the Site.</p> <p>The adoption of barrier type materials for potable water supply pipes in accordance with UK Water Industry Research (UKWIR) will be considered to prevent contaminant ingress (if present).</p> <p>To prevent any adverse effects to below ground structures, appropriate techniques and design solutions will be considered during the design of the proposed scheme, these will include Appropriate concrete in accordance with BRE Digest 1. 3rd Edition (including February 2018 amendments); and dedicated service corridors with clean, validated backfill.</p>



**Table 1-13 Assessment of likely significant effect and additional mitigation during construction – agricultural**

<b>Sensitive receptor</b>	<b>Agricultural Land</b>
<b>Likely Significant effects</b>	<p>Potential for loss of BMV land (over 20hectares) (46.9 hectares) (Grade 2 and Grade 3a).</p> <p>The impact will be managed by the correct handling and storage of the soils and consideration for temporary land use to be restore as much as possible.</p> <p>The sensitivity of agricultural land is High, and the magnitude of change following mitigation is Major resulting in a direct, permanent long-term Large adverse residual effect on agricultural Land (significant) effect.</p>
<b>Additional mitigation</b>	<p>Topsoil and subsoil to be stripped separately and to be tested for reuse potential.</p>



Operational Phase

**Table 1-14 Assessment of likely significant effect and additional mitigation during construction – human health**

Sensitive receptor	<p><b>Human Health – Maintenance workers</b></p> <p><b>Human Health – Future Site Users and Adjacent Site Users</b></p>
<p><b>Likely Significant effects</b></p>	<p>The occurrence of contamination will be addressed during the construction phase, this will include remediation works (where required) and mitigation measures as outlined above. Providing these are in place the potential for exposure of any residual contamination to maintenance workers and future site users will be limited.</p> <p>The sensitivity of human health receptors (Construction workers) is high, and the magnitude of impact after the implementation of embedded mitigation is negligible, resulting in a direct, long term, <b>neutral effect (not significant)</b>.</p> <p>The sensitivity of human health receptor (site users) due to very limited site exposure is deemed negligible and the magnitude of impact after the implementation of embedded mitigation is negligible, resulting in a <b>neutral effect (not significant)</b>.</p>
<p><b>Additional mitigation</b></p>	<p>The occurrence of contamination will be addressed during the construction phase, this will include remediation works (where required) and mitigation measures as outlined above. Providing these are in place the potential for exposure of any residual contamination to maintenance workers and future site users will be limited.</p>



**Table 1-15 Assessment of likely significant effect and additional mitigation during construction – controlled waters**

<p><b>Sensitive Receptor</b></p>	<p><b>Controlled Waters</b></p> <p><b>Groundwater – Principal and Secondary (A) Aquifers underlying the Proposed Scheme.</b></p> <p><b>Surface waters – On and off-site features including ponds and small streams bisecting the Proposed Scheme.</b></p>
<p><b>Likely Significant effects</b></p>	<p>The occurrence of contamination will be managed during the construction phase, this will include remediation works (where required) and mitigation measures as outlined above including the installation of hardstanding to limit vertical migration and installation of drainage and interceptors for any future fuel spillages from future site users. Providing these are in place the potential for exposure of any residual contamination to controlled waters will be limited.</p> <p>The sensitivity of controlled waters receptors (groundwater and surface waters) is High. The magnitude of change, following mitigation is Negligible. Therefore, there is likely to be an in-direct, temporary, long-term <b>Neutral</b> residual effect on controlled waters (not significant) following the implementation of mitigation measures.</p> <p>It is not anticipated that any follow-up or monitoring of the ground conditions will be required post-construction provided no significant groundwater contamination, soil contamination or ground gas is identified during the ground investigation and construction phase of the Proposed Scheme.</p>



<b>Sensitive Receptor</b>	<p><b>Controlled Waters</b></p> <p><b>Groundwater – Principal and Secondary (A) Aquifers underlying the Proposed Scheme.</b></p> <p><b>Surface waters – On and off-site features including ponds and small streams bisecting the Proposed Scheme.</b></p>
<b>Additional mitigation</b>	<p>The occurrence of contamination will be addressed during the construction phase, this will include remediation works (where required) and mitigation measures as outlined above. Providing these are in place the potential for exposure of any residual contamination will be limited.</p>

Assessment against Future Baseline

1.6.1 If the Proposed Scheme does not proceed, it is considered that in the future baseline, the conditions in relation to Ground Conditions and Contamination would remain relatively unchanged over the short/medium/long-term

**1.7 Opportunities for Environmental Enhancement**

1.7.1 No enhancement measures have been identified at this stage for the construction or operational stages of the Proposed Scheme apart from remediating contaminated soils and / or groundwater at the Site (if required). The removal of potentially contaminated material during the construction phase (if encountered), could result in betterment of the groundwaters at the Proposed Scheme due to the removal of the source material.

**1.8 Difficulties and Uncertainties**

1.8.1 This assessment has been undertaken with information available at the time of writing. Ground contamination is a material planning consideration and so further intrusive investigation is likely to be required prior to commencement of development.



## **1.9 Summary**

1.9.1 Table 1.16 provides a summary of the findings of the assessment.

**Table 1-16 Summary of Ground Conditions and Contamination effects**

Receptor	Potential Effects	Significance of Effects Prior to Mitigation/Enhancement	Additional Mitigation	Residual Effects	Monitoring
Human Health – Construction Workers, Current and adjacent users (Construction Phase)	Impact on the health of construction workers from contaminated soils, groundwater, particulate matter, dust vapours and ground gases (in confined spaces/buildings (if proposed)).	<b>Moderate to Large adverse (significant)</b> P/D/LT	Ground Investigation and Generic Quantitative Risk Assessment (GQRA) Remediation and validation works (if required) Materials Management Plan	<b>Neutral (not significant)</b> P/D/LT	Construction phase air monitoring may be used to check the effectiveness of damping down of the dust on-Site (carried out by appointed contractor and secured via the CEMP).  Monitoring of ground gas will be required as part of the Ground Investigation, prior to the construction phase (to be secured by a planning condition).
Controlled Waters - Groundwater – Secondary (A) and Principal Aquifers Surface waters, ponds and small streams (Construction Phase)	Impact of the disturbance / mobilisation of contaminated materials on Controlled water receptors.  Impact of spills on controlled waters	<b>Moderate to Large adverse (significant)</b> T/I/LT	Ground Investigation Piling Risk Assessment	<b>Negligible (not significant)</b> T/I/LT	Monitoring of groundwater levels will be required as part of the Ground Investigation, prior to the construction phase (to be secured by a planning condition).
Below Ground Services – Potable Water Supply Pipes, Buried Concrete and Foundations (Construction Phase)	Impact on below ground services due to exposure to contaminated soil and / or groundwater and deterioration of concrete due to aggressive ground.	<b>Moderate Adverse (significant)</b> P/D/LT	Ground Investigation Potable water supply pipes in accordance with UK Water Industry Research (UKWIR) Appropriate concrete in accordance with BRE Digest 1. 3rd Edition (including February 2018 amendments)	<b>Negligible (not significant)</b> P/D/LT	No monitoring.
Agricultural Land (Construction Phase)	Potential for loss of over 20 hectares of BMV land (Grade 2 and Grade 3a)	<b>Large Adverse (significant)</b> P/D/LT	Agricultural assessment	<b>Large adverse (significant)</b> P/D/LT	No monitoring.



Receptor	Potential Effects	Significance of Effects Prior to Mitigation/Enhancement	Additional Mitigation	Residual Effects	Monitoring
Human Health – Maintenance workers Human Health – Future users and adjacent users (Operational Phase)	Impact on the health of maintenance workers, future site users and adjacent site uses from contaminated soils, groundwater, particulate matter, asbestos, dust vapours, and ground gases.	<b>Moderate to Large adverse (significant)</b> P/D/LT	None providing all recommended remediation / validation works (where required) have been completed.	<b>Negligible (not significant)</b> P/D/LT	No monitoring provided no significant groundwater contamination, soil contamination or ground gas is identified during the ground investigation and construction phase of the Proposed Scheme.
Controlled Waters – Groundwater – Secondary (A) and Principal Aquifers Surface waters, ponds and small streams. (Operational Phase)	Impact of the disturbance / mobilisation of contaminated materials on Controlled water receptors. Impact of spills on controlled waters.	<b>Moderate to Large adverse (significant)</b> T/I/LT	None providing all recommended remediation / validation works (where required) have been completed.	<b>Negligible (not significant)</b> T/I/LT	No monitoring provided no significant groundwater contamination, soil contamination or ground gas is identified during the ground investigation and construction phase of the Proposed Scheme.

Key to table: P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable



## 1.10 References

- **Reference 12.1:** European Council, 2000. *Water Framework Directive 2000/60/EC*, s.l.: European Parliament and Council
- **Reference 12.2:** Environment Agency (2008) Science Report – SC050021/SR2 - Human Health Toxicological Assessment of Contaminants in Soil
- **Reference 12.3:** European Council, 2013. *DIRECTIVE 2013/39/EU* , s.l.: s.n
- **Reference 12.4.:** HMSO. (1990). Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance
- **Reference 12.5:** Secretary of State , 2012. Contaminated Land (England) (amendment) Regulations, s.l.: s.n.
- **Reference 12.6** Secretary of State, 2017. The Water Environment (Water Framework Directive) (England and Wales) Regulations, s.l.: s.n.
- **Reference 12.7** Secretary of State, 2016. *The Water Supply (Water Quality) Regulations*, s.l.: s.n
- **Reference 12.8** Water Resources Act 1991
- **Reference 12.9:** Ministry of Housing, Communities & Local Government, 2023. *National Planning Policy Framework (NPPF)*, s.l.: s.n.
- **Reference 12.10:** Borough Council of King’s Lynn & West Norfolk, 2017. *Neighbourhood plan*
- **Reference 12.11:** King’s Lynn & West Norfolk Borough Council, 2011. *Local Development Framework*
- **Reference 12.12:** Norfolk County Council, Site Allocations and Development Management Policies, 2016



- **Reference 12.13: Norfolk County Council**, Norfolk Minerals and Waste Development Framework, Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010 – 2026. 2011.
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