The Sizewell C Project

6.10 Volume 9 Rail

Chapter 12 Groundwater and Surface Water

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Contents

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Plates

None provided.

Figures

Appendices

None provided.

12 Groundwater and Surface Water

12.1 Introduction

12.1.1 This chapter of **Volume 9** of the **Environmental Statement (ES)** presents an assessment of the potential effects on groundwater and surface water arising from the construction and operation of proposals relating to rail.

12.1.2 The proposals considered in this volume are as follows:

- the part of the green rail route comprising a temporary rail extension of approximately 1.8 kilometres (km) from the existing Saxmundham to Leiston branch line to the proposed B1122 (Abbey Road) level crossing (the 'proposed rail extension route') as shown on **Figure 2.1** of this volume; and

- Saxmundham to Leiston branch line upgrades (including track replacement and level crossing upgrades) (the 'proposed rail improvement works') as shown as **Figure 2.11** of this volume, (together the 'proposed development').

12.1.3 The proposed green rail route in its entirety comprises of a temporary rail extension of approximately 4.5km from the existing Saxmundham to Leiston branch line to a terminal within the main development site. The 2.7km part of the green rail route between the proposed B1122 (Abbey Road) level crossing and the terminal within the main development site is detailed and assessed in **Volume 2, Chapters 1** to **5** of the **ES** (Doc Ref. 6.3)

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

12.1.5 Detailed descriptions of the proposed development sites (referred to throughout this volume as the 'site' as relevant to the location of the works), the proposed development, and different construction, operation, and where relevant, the removal and reinstatement phases are provided in **Chapters 1** and **2** of this volume of the **ES**. A glossary of terms and list of abbreviations used in this chapter is provided in **Volume 1**, **Appendix 1A** of the **ES** (Doc Ref. 6.2).

12.1.6 The Government's Good Practice Guide for Environmental Impact Assessment (EIA)[1] (Ref. 12.1) outlines the potential environmental effects

[1] This document has been withdrawn but still constitutes good advice and is referred to in the absence of alternative guidance.

that should be considered for groundwater and surface water, for example, the physical effects of the development and effects on groundwater. Further information on these topics and those which have been scoped into the assessment can be found in **section 12.3** of this chapter.

12.1.7 This assessment has been informed by data from other assessments as following:

- **Appendix 11A** of this volume: Rail Infrastructure: Phase 1 Desk Study Report, 2020;
- **Appendix 11B** of this volume: conceptual site models;
- **Appendix 11C** of this volume: impact assessment tables;
- **Rail Flood Risk Assessment** (Doc Ref. 5.9); and
- **Water Framework Directive Compliance Assessment** (Doc Ref. 8.14).

12.2 Legislation, policy and guidance

12.2.1 **Appendix 6O** of **Volume 1** of the **ES** (Doc Ref. 6.2) identifies and describes legislation, policy and guidance of relevance to the assessment of the potential groundwater and surface water impacts associated with the Sizewell C Project across all **ES** volumes.

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

a) International

12.2.3 International legislation or policy relevant to the groundwater and surface water assessment includes:

- Water Framework Directive 2000/60/EC (Ref. 12.2);
- Groundwater Daughter Directive 2006/118/EC (Ref. 12.3); and
- The Discharge of Dangerous Substances into the Aquatic Environmental Directive 2006/11/EC (Ref. 12.4).

12.2.4 The requirements of these, as relevant the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES.**

b) National

i. Legislation

12.2.5 National legislation relevant to the groundwater and surface water assessment includes:

- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (Ref. 12.5);
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (Ref. 12.6);
- Environmental Permitting Regulations (England and Wales) 2016 (Ref. 12.7);
- Water Resources Act 1991 (Ref. 12.8);
- Water Act 2003 (Ref. 12.9); and
- Flood and Water Management Act 2010 (Ref. 12.10).

12.2.6 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES.**

ii. Planning policies

12.2.7 The National Policy Statements (NPS) set out national policy for energy infrastructure. The overarching NPS for Energy (EN-1) (Ref. 12.11) and NPS for Nuclear Power Generation (EN-6) (Ref. 12.12) provide the primary policy framework within which the development will be considered. A summary of the relevant planning policy, together with consideration of how these have been taken into account, is provided in **Appendix 6O** of **Volume 1** of the **ES.**

12.2.8 Other national policies relevant to the groundwater and surface water assessment includes the National Planning Policy Framework (NPPF) (Ref. 12.13).

12.2.9 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES.**

c) Regional

12.2.10 Regional policies relevant to the groundwater and surface water assessment includes:

- Environment Agency Anglian River Basin Management Plan (RBMP) (Ref. 12.14);
- The East Suffolk Abstraction Licensing Strategy 2017 (Ref. 12.15); and
- Environment Agency East Suffolk Catchment Flood Management Plan 2009 (Ref. 12.16).

12.2.11 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES**.

d) Local

12.2.12 Local policies relevant to the groundwater and surface water assessment includes:

- Suffolk Flood Risk Management Strategy (Ref. 12.17);
- Strategic Flood Risk Assessment (Ref. 12.18);
- Strategic Coastal District Council (SCDC) Local Plan Core Strategy and Development Management Policies (Ref. 12.19); and
- SCDC Final Draft Local Plan (Ref. 12.20).

12.2.13 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES**.

e) Guidance

12.2.14 Guidance relevant to the groundwater and surface water assessment includes:

- Planning Practice Guidance (Ref. 12.21);
- Government's 25 Year Environment Plan (Ref. 12.22);
- The Government's Good Practice Guide (Ref. 12.23) for EIAs; and
- The Groundwater Protection Position Statements Guidance (Ref. 12.24).

- Control of water pollution from construction sites: A guide to good practice, Construction Industry Research and Information Association (2001) (Ref. 12.25);
- Environment Agency's Pollution Prevention Guidelines: Working on construction sites (Ref. 12.26);
- The Design Manual for Roads and Bridges (DMRB) (2008) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects (Ref. 12.27); and
- DMRB (2009) Volume 11, Section 3, Environmental Assessment Techniques (Ref. 12.28).

12.2.15 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Appendix 6O** of **Volume 1** of the **ES**.

12.3 Methodology

a) Scope of the assessment

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

12.3.2 The full method of assessment for groundwater and surface water that has been applied for the Sizewell C Project is included in **Appendix 6O** of **Volume 1** of the **ES**.

12.3.3 This section provides specific details of the groundwater and surface water methodology applied to the assessment of the proposed development and a summary of the general approach to provide appropriate context for the assessment that follows. The scope of this assessment considers the impacts of the construction, operation, and removal and reinstatement phases of the proposed development.

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

12.3.5 The scope of this assessment has been established through a formal EIA scoping process undertaken with the Planning Inspectorate. A request for an EIA Scoping Opinion was initially issued to the Planning Inspectorate in 2014,

with an updated request issued in 2019, provided in **Appendix 6A** of **Volume 1** of the **ES**.

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

12.3.7 The Government's Good Practice Guide for EIA states that the following potential environmental effects should be considered for water environment:

- levels and effects of emissions to water from the development;
- abstractions of/effects on surface or groundwater resources;
- effects of development on drainage or run-off pattern in the area;
- changes to groundwater level, watercourses and flow of underground water;
- crossings of watercourses; and
- effects of pollutants on water quality.

12.3.8 Additionally, consideration should be given to flood risk as well as Water Framework Directive compliance, and their interactions with other assessments such as geology and land quality, and terrestrial ecology and ornithology assessments.

12.3.9 Potential impacts from existing and new contamination sources on controlled waters have been considered as part of the geology and land quality assessment in **Chapter 11** of this volume to determine and classify potential effects associated with ground contamination. The assessment of effects from contamination to groundwater and surface water is reported in this chapter.

b) Consultation

12.3.10 The scope of the assessment has also been informed by ongoing consultation and engagement with statutory consultees throughout the design and assessment process as outlined in **Appendix 6O** of **Volume 1** of the **ES**.

c) Environmental screening

12.3.11 The proposed development has the potential to result in environmental effects which could be significant and therefore these works have been considered in the environmental assessment.

12.3.12 An environmental screening exercise was undertaken to identify which of the works on the Saxmundham to Leiston branch line may give rise to environmental effects that could potentially be significant.

12.3.13 All of the Saxmundham to Leiston branch line upgrade works have been screened out of the groundwater and surface water assessment as they are not likely to give rise to significant environmental effects.

12.3.14 **Table 12.1** provides a summary of the environmental screening exercise.

Table 12.1: Summary of environmental screening exercise

Proposed Improvement	Summary of Potential Effects	Screened in or out of the Assessment
Saxmundham to Leiston branch line track replacement.	Replacement of the track would involve only shallow excavation and would all take place within the extent of the existing line. The track replacement would be completed to current best practice and would meet Network Rail standards for freight transport. Drainage would be managed through primary mitigation methods. Introduction of contaminants during construction and operation would be managed through tertiary mitigation measures. The assessment for effects on controlled waters from on-site contamination carried out in **Chapter 11** of this volume and its appendices identified a negligible effect to all controlled waters. There would therefore be no effect on groundwater and surface water receptors.	Screened out.
Level Crossings		
Bratts Black House; Snowdens; Buckles Wood; and Summerhill.	All works to upgrade the level crossing would be within the rail land boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted.	Screened out.
Knodishall	The majority of the works would be within the rail land boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. There would be minor land take requirements from outside the existing rail land boundary (highways land and a small area of arable cultivation to the south of the railway).	Screened out.

Proposed Improvement	Summary of Potential Effects	Screened in or out of the Assessment
West House	The majority of the works would be within the rail land boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. There would be minor land take requirements from outside the existing rail land boundary (existing lane and a small area of arable cultivation to the south of the railway).	Screened out.
Saxmundham Road	The majority of the works would be within the rail land boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. There would be minor land take requirements from outside the existing rail land boundary (highways land and a small area of scrub, road verge and arable cultivation to the north of the railway).	Screened out.
Leiston	The majority of the works would be within the rail land boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. There would be minor land take requirements from outside the existing rail land boundary (highways land and existing hard standing within the former Garret's works).	Screened out.

d) Study area

12.3.15 The study area for the consideration of effects from contaminative sources on controlled waters is discussed in **Chapter 11** of this volume and includes the site and land immediately beyond it to a distance of 500 metres (m) from the site boundary. This is hereafter referred to as the inner study area.

12.3.16 The size of the inner study area takes into account the transport of potential contaminants of concern in the environment and the connectivity of these contaminants via pathways of migration or exposure to the receptors and resources identified.

12.3.17 The general methodology adopted for the consideration of effects on groundwater and surface water levels and flows, and water dependent receptors and resources extends beyond this inner study area to a distance of 1 kilometre (km) from the site boundary. This is termed the outer study area.

12.3.18 The size of the outer study area allows for any potential physical changes resulting from the proposed development that may propagate through the water environment and beyond the inner study area to be assessed.

12.3.19 The site boundary and study areas are presented in **Figure 12.1** of this volume.

e) Assessment scenarios

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

f) Assessment criteria

12.3.21 As described in **Volume 1**, **Chapter 6** of the **ES**, the EIA methodology considers whether impacts of the proposed development would have an effect on any receptors or resources. Assessments broadly consider the magnitude of impacts and value/sensitivity of receptors/resources that could be affected in order to classify effects.

i. Assessment of physical impacts

12.3.22 Physical impacts include:

- changes or alterations to water levels and flow regimes of groundwater and surface water receptors and resources; and
- changes to water dependent groundwater and surface water receptors and resources.

12.3.23 The assessment criteria of physical impacts on groundwater and surface water receptors and receptors are based on the methodology provided in **Appendix 6O** of **Volume 1** of the **ES** and summarised in the following sub-sections.

Sensitivity

12.3.24 The assessment of assigning the levels of sensitivity to receptors and resources is set out in **Table 12.2**.

Table 12.2: Assessment of the value or sensitivity of receptors and resources for groundwater and surface water

Value or Sensitivity	Description
High	An attribute with a high quality/rarity, international or national significance that has a low capacity to accommodate disturbance or change.
Medium	An attribute with high quality/rarity, national scale and some resilience to disturbance or change.

Value or Sensitivity	Description
	An attribute with high quality/rarity, at a regional scale that has a low capacity to accommodate disturbance or change. An attribute with medium quality/rarity, national scale that has a low capacity to accommodate disturbance or change.
Low	An attribute with medium quality/rarity, national or regional scale and some resilience to disturbance or change. An attribute with low quality/rarity, national or regional scale and some resilience to disturbance or change.
Very Low	An attribute with low quality/rarity, regional and local scale and resilience to disturbance or change.

Magnitude

12.3.25 The magnitude of a potential impact is estimated based on the likely level of change and is independent of the importance of the feature. The definitions of magnitude classifications are provided in **Table 12.3**.

Table 12.3: Assessment of magnitude of impact on groundwater and surface water

Magnitude	Criteria
High	Large-scale permanent/irreversible, or long-term temporary, changes over the whole development area and potentially beyond (such as off-site), to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Medium	Medium-scale permanent/irreversible, or medium-term temporary, changes over the majority of the development area and potentially beyond, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Low	Noticeable but small-scale change, permanent or temporary changes over a partial area, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Very Low	Noticeable, but very small-scale change, or barely discernible changes for any length of time, over a small area, to key characteristics or features of the particular environmental aspect's character or distinctiveness.

12.3.26 Where the assessment of potential impact concludes that through careful design and the application of appropriate mitigation, there will be no discernible change (no impact) to a receptor or resource, then a conclusion of no effect will be drawn.

12.3.27 Given the timescales of the Sizewell C Project, the nature of potential changes to the water environment from the proposed development and their reversibility, the definitions of temporary impacts are categorised as follows:

- short-term = less than six months;

- medium-term = between six months and six years; and
- long-term = more than six years.

Effect definition

12.3.28 The classification of the likely effect for groundwater and surface water are determined using the matrix presented in **Table 12.4**.

Table 12.4: Classification of effects

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

12.3.29 An effect can be ‘adverse’ or ‘beneficial’ depending on the nature of impact on the quality and integrity on the receptor or resource. For example, an adverse effect would be where there would be a loss or damage to the quality or integrity of an attribute, whereas a beneficial effect would arise from the creation of a new or an improvement to an attribute.

12.3.30 Following the classification of an effect as presented in **Table 12.4**, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

ii. Assessment of contamination to controlled waters

12.3.31 The assessment of potential impacts from existing and new contamination sources on controlled waters has been considered as part of the geology and land quality assessment in the production of the Preliminary Conceptual Site Model (PCSM) to determine and classify potential effects.

12.3.32 Further details on the methodology applied is provided in **Volume 1, Appendix 6N** of the **ES**, and summarised in **Chapter 11** of this volume.

iii. Water Framework Directive compliance

12.3.33 Water Framework Directive impacts are assessed differently to the approach conventionally used within the EIA process and require an assessment of whether a project (or an element of a project) is compliant or non-compliant with the environmental objectives outlined in Article 4 of the Water Framework Directive.

12.3.34 The significance of effects on Water Framework Directive status relates only to compliance or non-compliance. Non-compliance will only occur because of permanent impacts that cannot be mitigated, irrespective of the degree of vulnerability to change of the receptor. The assessment in this context will be restricted to either compliance or non-compliance.

12.3.35 The **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) has been provided as a separate document as part of this application for development consent. The main conclusions with relevance to the activities considered as part of the EIA are summarised in this chapter.

iv. Flood risk assessment

12.3.36 The **Rail Flood Risk Assesment** (Doc Ref. 5.9) has been provided as a separate document as part of this application for development consent. The main conclusions from the **Rail Flood Risk Assessment** (Doc Ref. 5.9) with relevance to the potential flood sources affecting the site and the impacts that the proposed development would have on altering the flood risk levels relating to the surrounding surface water receptors are summarised in this chapter.

g) Assessment methodology

12.3.37 **Volume 1**, **Chapter 6** of the **ES** sets out the broad approach to impact assessment employed within the overall **ES**. This section details the approach to the assessment of impacts specifically relating to groundwater and surface water.

i. General approach

12.3.38 The approach to the groundwater and surface water assessment comprises:

- establishing the baseline conditions for the study area with respect to geology, hydrology, hydrogeology, and water dependent resources and receptors;

- identification of potential impacts on identified water dependent receptors and resources from the construction, operation and removal and reinstatement phases of the proposed development;
- assessment of the significance of likely effects from the proposed development including the consideration of primary and tertiary mitigation measures; and
- identification of any residual effects and secondary mitigation where required.

12.3.39 The assessment also considers the findings of the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14), and **Rail Flood Risk Assessment** (Doc Ref. 5.9).

ii. Existing baseline

12.3.40 Existing baseline conditions are defined based on available published and site-specific information.

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

- publicly available information from the British Geological Survey (BGS) online mapping resource (Ref. 12.29);
- publicly available information from the Environment Agency (Ref. 12.30 and Ref. 12.31);
- publicly available information from the Defra's Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref. 12.32);
- **Appendix 18A** of **Volume 2** of the **ES** (Doc Ref. 6.3): Sizewell C: Phase 2 Geo-Environmental Interpretative Report, which includes the factual report from the Structural Soils 2014 Ground Investigation; and
- **Appendix 11A** of this volume**:** Rail Infrastructure: Phase 1 Desk Study Report, which includes the Landmark Envirocheck Report for the site and study area, and details of the site walkover.

iii. Future baseline

12.3.42 The future baseline is typically established upon extrapolating the current baseline using technical knowledge of changes (for example changes in

rainfall) and future climate forecasts to predict the environmental conditions at a future point in time. This assessment considers future baseline conditions solely in the context of known future developments and predictable changes in the quality of receptors (for example forecast improvements in the status of Water Framework Directive water bodies).

iv. Assessment

12.3.43 Potential changes to the water environment in terms of water levels, flow and quality are considered qualitatively against baseline conditions. Should a significant effect be identified at the end of the qualitative assessment, a more detailed quantitative appraisal of potential impacts on water levels and flow has been undertaken to determine the magnitude and extent of potential changes.

h) Assumptions and limitations

12.3.44 The following assumptions have been made in this assessment:

- All assessment considers development within the site parameters as set out in the description of development at **section 2.3** of **Chapter 2** of this volume of the **ES** and as illustrated on the work plans reproduced in **Appendix 2A** of this volume;
- surface water discharge will be managed so it does not exceed the predetermined Greenfield run-off rates in accordance with the **Outline Drainage Strategy**, as provided in **Appendix 2A** of **Volume 2** of the **ES**; and
- Environmental Quality Standards prescribed for downstream designated WFD water bodies have been adopted for upstream, non-designated watercourses for the purposes of this assessment, in order to consider the worst case scenario.

12.3.45 The following limitations have been identified:

- Ground investigation data is not available for the majority of the site and the baseline has been prepared using BGS mapping supplemented by eight exploratory hole logs available for the proposed rail extension route.
- No groundwater quality data is available for the site, however given the site setting and historical land use there is a low risk of poor quality groundwater. Potential sources of contamination have been considered in **Chapter 11** of this volume and this has informed the assessment.

12.4 Baseline environment

12.4.1 This section presents a description of the baseline environmental characteristics within the site and study area.

12.4.2 Further detail can be found in the Rail Phase 1 Desk Study Report, as provided in **Appendix 11A** of this volume.

a) Current baseline

i. Rail extension route

Site walkover

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

12.4.4 The site comprises agricultural fields, with the existing Saxmundham to Leiston branch line present within the south-western edge of the site. Buckleswood Road is also present in the south of the site, crossing the proposed rail extension route from north-west to south-east. Further details on observations made during the site walkover including photographs can be found in the Desk Study, as provided in **Appendix 11A** of this volume.

Topography

12.4.5 Light Detection and Ranging data for the site shows that the highest ground levels, slightly above 23m Above Ordnance Datum (AoD), are located in the southern extent of the site. Ground levels become progressively lower to the north of the site, with the lowest ground levels slightly below 7m AoD at the north-east edge.

Geology

12.4.6 There is the potential for Made Ground to be present associated with the existing railway line, roads crossing the site, small scale structures and the old sand pits located in the vicinity of the site.

12.4.7 Online BGS mapping indicates that the superficial geology underlying the majority of the site is the diamicton (boulder clay) deposits of the Lowestoft Formation. The north-eastern area of the site is underlain by the sands and gravels of the Lowestoft Formation, which is formed of a sheet of chalky till, together with outwash sands and gravels, silts and clays.

12.4.8 The bedrock geology beneath the site comprises Crag Group. The Crag Group is made up of shallow water marine and estuarine sands, gravels, silts and clays.

12.4.9 A ground investigation encompassing a section of the rail extension route was undertaken in 2014, as provided in **Appendix 18A** of **Volume 2** of the **ES**. Eight exploratory holes (GR1 to GR7 and GR11) were drilled in the vicinity of the site and are reported in **Appendix 18A** of **Volume 2** of the **ES**. The ground investigations report states that ground conditions encountered are consistent with those indicated by published geological records, with the boreholes within the site confirming the presence of the Crag bedrock, overlain by superficial deposits of the Lowestoft Formation (diamicton).

12.4.10 The boundary between the Crag Group and the Lowestoft Formation (diamicton) was found to be indistinct in places. The thickness of superficial deposits was generally found to increase with distance from the coast, with a maximum thickness of 7.3m of Lowestoft Formation (diamicton), with an additional 7.2m of probable Lowestoft Formation (diamicton) encountered at GR2.

12.4.11 Further detail on the geology of the site is presented in **Chapter 11** of this volume.

Hydrogeology

12.4.12 The Environment Agency classifies the sand and gravel of the Lowestoft Formation as a Secondary A Aquifer[2] and the Lowestoft Formation (diamicton) as a Secondary Aquifer (undifferentiated)[3].

12.4.13 The Environment Agency classifies the Crag Group bedrock underlying the site as a Principal Aquifer[4].

12.4.14 The eastern and northern section of the site does not lie within a groundwater Source Protection Zone (SPZ)[5]. The south-western section of the site lies

[2] Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
[3] A Secondary (Undifferentiated) Aquifer is designated in cases where it has not been possible to attribute either category Secondary A or Secondary B to a rock type.
[4] Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
[5] Groundwater Source Protection Zones are areas defined around groundwater sources used for public drinking water supply. The SPZ shows the risk of contamination from activities that might cause pollution in the area. The closer the activity, the greater the risk

within the Outer Zone (Zone 2)[6], or Total Catchment (Zone 3)[7] of an SPZ. The inner protection zone (Zone 1)[8] is approximately 1km south of the site. The SPZs are presented on **Figure 12.1** of this volume. The outer study area is not within a groundwater drinking water safeguard zone.

12.4.15 As part of the ground investigation undertaken within the site, groundwater monitoring installations were installed at GR2, GR3, GR6 and GR11 as illustrated in **Figure 19.3** in **Volume 2** of the **ES**. Groundwater level monitoring was undertaken at these boreholes in March and April 2014 and reported in the factual and interpretative reports. Groundwater levels have also been monitored as part of the current groundwater monitoring regime discussed in **Volume 2, Chapter 19** of the **ES**. The observed groundwater levels are summarised in **Table 12.5**.

Table 12.5: Observed groundwater level summary

Location	Response Zone	Groundwater Level Range m Below Ground Level (bgl)	Groundwater Level Range mAoD
GR2	Probable Lowestoft Formation (diamicton)/Probable Crag.	17.60 to 16.85	4.25 to 4.99
GR3	Probable Crag.	15.85 to 15.14	4.03 to 4.74
GR6	Lowestoft Formation (diamicton).	6.58 to 2.75	9.21 to 13.04
GR11	Crag Group.	8.14 to 7.05	2.70 to 3.79

12.4.16 Permeability testing was undertaken across the wider area as part of the associated development Ground Investigation the outcomes of which are reported in **Appendix 18A** of **Volume 2** of the **ES** and summarised in **Table 12.6**.

Table 12.6: Summary of permeability testing

Permeability Test	Response Zone	Permeability Range (m/s)
Falling head (during drilling).	Not specified.	3.84×10^{-4} to 1.33×10^{-6}

[6] Outer Protection Zones (Zone 2) are defined by the 400-day travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500m, depending on the size of the abstraction. The travel time is derived from consideration of the time required to provide delay, dilution and attenuation of slowly degrading pollutants.

[7] Total catchments (Zone 3) are defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management;

[8] Inner Protection Zones (Zone 1) are defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50m radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease

Permeability Test	Response Zone	Permeability Range (m/s)
Falling head tests (in installations).	Not specified.	6.76×10^{-6} to 2.23×10^{-7}
Soakaway tests.	Cohesive soils of Lowestoft Formation (diamicton).	6.22×10^{-6} to 9.94×10^{-9}
Soakaway tests.	Granular soils of Lowestoft Formation (diamicton) and Crag.	2.17×10^{-3} to 2.09×10^{-5}

12.4.17 The Lowestoft Formation (diamicton) at the site is expected to be of relatively low permeability and therefore have a limited hydraulic connection to the underlying Crag groundwater. It is likely that there are perched water tables in permeable lenses within the Lowestoft Formation.

12.4.18 The site is located on the Waveney and East Suffolk Chalk and Crag groundwater body (water body ID GB40501G400600). This groundwater body has been classified by the Environment Agency during the 2016 classification as being of poor quantitative and poor chemical status, with an objective to being of good quantitative and good chemical status by 2027. The poor chemical status is attributed to impacts from agriculture as evidenced by elevated nitrate concentrations in groundwater. The site falls within a groundwater Nitrate Vulnerable Zone.

Surface water features

12.4.19 The site is located within the Leiston drain catchment (Leiston Beck water body ID GB105035046271) (Ref. 12.33) and Hundred River catchment (water body ID GB105035046260) (Ref. 12.34). The water bodies are presented on **Figure 12.1** of this volume.

12.4.20 A series of ditches cross the site, which in turn feed the upper reaches of the Leiston drain to the east of the B1122 (Abbey Road). The upper reaches of the channels are Ordinary Watercourses, whilst the Main River limit is at Lover's Lane, approximately 950m to the east of the site. The WFD reported reach of the Leiston drain, designated as the Leiston Beck, has the same upstream and downstream boundaries as the Main River. Both the B1122 (Abbey Road) and Lover's Lane separate the site from this watercourse. The Environment Agency catchment data explorer 2016 classification states that the Leiston Beck water body has an overall classification of Moderate ecological potential. The Hundred River, which is a designated Main River is approximately 740m to the west of the site. The Hundred River water body has a moderate ecological potential for the Environment Agency 2016 classification.

12.4.21 There are no existing ponds within the site boundary, but there are ponds within the outer study area.

Water quality

12.4.22 The 2016 physico-chemical and chemical data presented on Catchment Data Explorer for the Leiston Beck and Hundred River water bodies have been reviewed to characterise the catchments.

12.4.23 Physico-chemical data indicate that the Leiston Beck water body is at good or high WFD status for ammonia, pH and temperature, and is not adversely affected by pollutants such as copper, zinc and triclosan. The water body is at moderate physico-chemical status as a result of bad dissolved oxygen and poor phosphate concentrations, and as a result the overall ecological status is classified as moderate. This suggests that water quality in the catchment is under stress, either from diffuse or point sources of pollution as there is evidence of eutrophication (high nutrient levels and low dissolved oxygen). Channel morphology may be exacerbating the effects of pollution.

12.4.24 Physico-chemical data indicate that the Hundred River is at good or high Water Framework Directive status for ammonia, pH and temperature. Dissolved oxygen is at bad Water Framework Directive status and phosphate is at moderate status. Overall, the water body is at moderate physico-chemical status. As with Leiston drain, this suggests that water quality in the catchment is under stress, either from diffuse of point sources of pollution. Channel morphology may be exacerbating the effects of pollution.

12.4.25 No groundwater quality data is available for the site.

Groundwater and surface water interaction

12.4.26 Given the local geology and depth to groundwater it is not considered that there is a connection between groundwater and the surface water features identified.

Water abstractions

Groundwater

12.4.27 Twelve licensed groundwater abstractions have been identified within the outer study area. These are detailed in **Table 12.7** and presented on **Figure 12.1** of this volume.

Table 12.7: Licensed groundwater abstractions within the outer study area

Licence Number	Location (including National Grid Reference (NGR))	Source	Purpose	Maximum Annual Abstraction (m3)
7/35/03/*G/0008	642820, 262910 (264m south-west of site). Well at House Farm, Leiston.	Crag Groundwater.	General Farming and Domestic.	Unknown
7/35/03/*G/0025	644000, 263100 (365m east of site). Bore/well at West End Nurseries.	Crag Groundwater.	General Agriculture: Spray Irrigation.	205,000
7/35/03/*g/044	644450, 263310 (390m east of site). Bore, Coldfair Green, Knodishall.	Glacial Sand and Gravel Groundwater.	Public Water Supply.	909,000
7/35/03/*G/0065	644200, 263200 (525m east of site). Ten Well pits North of Westward House.	Crag Groundwater.	General Agriculture: Spray Irrigation. Seasonal – 01 March to 30 September	Unknown
An/035/0003/007	645100, 263500 (660m east of site). Groundwater Basin A at Aldhurst Farm, Leiston.	Glacial Sand and Gravel Groundwater.	Environmental: Non-remedial River/Wetland Support: Transfer between sources.	Unknown
7/035/03/*G/0049	645100, 263500 (660m east of site). 15 wellpoints NE of Brick Wks Farm	Groundwater	General Agriculture: Spray Irrigation. Seasonal – 01 April to 30 September	Unknown
7/35/03/*G/0051	645050, 264250 (660m north-east of site). Bore Nr Leiston Old Abbey, Leis	Glacial Sand and Gravel	General Farming and Domestic	Unknown

Licence Number	Location (including National Grid Reference (NGR))	Source	Purpose	Maximum Annual Abstraction (m3)
7/35/03/**/051	645190 263765 (670m east of site). Bore near Leiston Old Abbey. NB: Listed as a surface water abstraction in the Envirocheck Report, however this is assumed to be an error, given the location description as a bore and the lack of surface watercourses in the vicinity	Groundwater	Spray Irrigation	500,000
An/035/0003/009	645050, 263234 (750m east of site). Borehole at Aldhurst Farm.	Groundwater	Non-remedial River/Wetland Support: Supply to a Leat for Throughflow.	Unknown
An/035/0003/007	645315, 263419 (890m east of the site). Groundwater Basin C at Aldhurst Farm, Leiston.	Groundwater	Environmental: Non-remedial River/Wetland Support: Transfer between sources.	Unknown
An/035/0003/007	645342, 263431 (920m east of site). Groundwater Basin B at Aldhurst Farm, Leiston.	Groundwater	Environmental: Non-remedial River/Wetland Support: Transfer between sources.	Unknown
An/035/0003/007	645297, 263362 (920m east of site). Groundwater Basin B at Aldhurst Farm, Leiston.	Groundwater	Environmental: Non-remedial River/Wetland Support: Transfer between sources.	Unknown

12.4.28 Whilst the Landmark Envirocheck Report, as provided in **Appendix 11A** of this volume, lists a licence for a public water supply (7/35/03/*g/044), the abstraction is potentially no longer active, due to the lack of a SPZ associated with the location of the abstraction.

12.4.29 There is the potential for unknown private water supplies (PWS) to be in use within the outer study area. Should any PWS exist, they would likely be associated with the isolated farm buildings and residential properties in the outer study area. It is likely that the properties within the village of Leiston obtain their water from a mains supply source.

Surface water

12.4.30 One licensed surface water abstraction within the outer study area. This abstraction is listed in **Table 12.8** and presented on **Figure 12.1** of this volume.

Table 12.8: Licensed surface water abstractions within the outer study area

Licence Number	Location (including NGR)	Source	Purpose	Maximum Annual Abstraction (m3)
7/35/03/**/049	645150 263495 (700m east of site). North East of Brick Works Farm.	Stream	Spray Irrigation	300,000

Fluvial geomorphology

12.4.31 Geomorphology and hydromorphology underpin the WFD, being key factors contributing to whether a water body can achieve or maintain Good Ecological Status.

12.4.32 The drainage network on the site is largely manmade, albeit formalising what would most likely have been ephemeral water features. Downstream of the site, the Leiston Beck water body is designated as a heavily modified water body (HMWB), which has been straightened, over-deepened and over-widened. The hydrological regime is of sufficient quality to support good status, but the prescribed WFD mitigation measures[9] have not been fully delivered. Overall, it is at moderate ecological potential.

12.4.33 The Hundred River is also designated as an HMWB. All prescribed WFD mitigation measures have been implemented and the hydrological regime is of sufficient quality to support good status.

Flood risk

12.4.34 The East Suffolk Council Strategic Rail Flood Risk Assessment did not identify any historic flooding as having occurred within the site.

12.4.35 The Environment Agency's Flood Map for Planning indicates that the site is located in Flood Zone 1, and therefore has a low risk of flooding from tidal or fluvial sources without defences as shown in **Figure 12.1** of this volume. Risks associated with groundwater, sewer and reservoir flooding at the site are also considered to be low. The Environment Agency's long-term flood

[9] It should be noted that these mitigation measures are not relevant to the proposed development but have been implemented by others to meet WFD targets.

risk mapping shows that the majority of the site is also at very low risk of flooding from surface water. However, an approximately 2 hectares (ha) area of high surface water flood risk is located along the eastern boundary of the site. This represents approximately 9% of the total site area. This represents a surface water flow route along the field boundary (e.g. a ditch), which connects to the ordinary watercourse adjacent to B1122 (Abbey Road).

12.4.36 Further information on flood risk at the site is provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) which has been submitted as part of this application for development consent.

Historic and environmentally sensitive sites

12.4.37 The Sizewell Marshes Site of Special Scientific Interest (SSSI) is located approximately 930m east of the site. The SSSI is a Groundwater Dependent Terrestrial Ecosystem and hydrologically linked to the site via the Leiston drain. In addition, the Aldhurst Farm habitat creation scheme is located approximately 500m to the east of the site. There are no international statutory designated ecological sites present within the outer study area.

12.4.38 Given the local geology and depth to groundwater it is considered that while there is a connection between groundwater and the designated features identified above, potential impacts would be identified in the aquifers closer to the site. If significant impacts are identified on these aquifers, the impact to the designated features will be considered further. Similarly, if significant impacts are identified for Leiston drain, then the impact to the designated features will be considered further. However, should no significant impacts be identified on aquifers or Leiston drain, it can be inferred that there will be no impact on the designated features.

12.4.39 Further consideration of designated historic and ecological sites, both statutory and non-statutory, is given in terrestrial ecology and ornithology and terrestrial historic environmental chapters – **Chapters 7** and **9** of this volume.

Existing buildings

12.4.40 Changes in groundwater level have the potential to affect building foundations. There are no existing buildings present on-site, however, there are several residential properties, farms and associated buildings within the outer study area, including the village of Leiston to the south. Wood Farm (south) and Aldhurst Farm (north) are both adjacent to the site boundary. Leiston Abbey scheduled monument is located approximately 175m north of the site.

12.4.41 Further consideration of existing buildings within the study area is given in **Chapter 9** of this volume.

Potential for existing contamination

12.4.42 The following potential existing contamination sources are discussed in **Chapter 11** of this volume :

- historical site usage;
- waste management sites;
- service stations;
- industrial and other potentially contaminative land uses;
- potential for Unexploded Ordnance; and
- previous ground investigation, where applicable.

12.4.43 The potential sources of contamination at the site are presented in the PCSM in **Chapter 11** of this volume.

Summary of key receptors

12.4.44 The key receptors for potential effects are summarised in **Table 12.9.**

Table 12.9: Key receptors within the outer study area

Receptor	Receptor Sensitivity to Physical Effects	Receptor Sensitivity to Contaminative Effects
Crag groundwater (Principal Aquifer and SPZ2 and SPZ3)	Medium	Medium
Lowestoft Formation groundwater – Sand and Gravel (Secondary A Aquifer)	Low	Medium
Lowestoft Formation (diamicton) groundwater (Secondary Aquifer (undifferentiated))	Very low	Medium
Groundwater abstractions	Medium	Medium
Potential PWS	Medium	Medium
Existing buildings	Medium	Medium
Leiston drain (Main River)	Medium	Low
Hundred River (Main River)	Medium	Low
Existing drainage network	Very low	Low
Surface Water abstractions	Medium	Low

b) Future baseline

12.4.45 Committed developments have been considered as future receptors in the assessment of groundwater and surface water impacts during the construction, operation and removal and reinstatement phases of the proposed development. There are several committed developments which have been identified within the outer study area as summarised in **Table 12.10.**

Table 12.10: Committed developments

Planning Application Ref	Site Address	Description of Development	Date of Approval	Status	Distance (m)
Rail extension route					
DC/14/3166/OUT	Abbey View Lodges Orchard House 105 Abbey Road Leiston Suffolk IP16 4TA	Application for outline planning permission with all matters reserved for redevelopment of the site for ten dwellings.	10/04/2015	Construction commenced	37
DC/16/1961/OUT	Johnsons Farm Saxmundham Road Leiston Suffolk	An outline planning application for up to 187 dwellings to include car parking, open space provision with associated infrastructure and access.	21/06/2017	DC/19/1883/ARM pending consideration	170
DC/16/2104/OUT	Land at The Rear of St Margarets Crescent Leiston Suffolk	Erection of up to 77 new homes with associated access, infrastructure, landscaping and amenity space (all matters to be reserved except for access).	29/06/2017	Construction not commenced	252
DC/17/1617/FUL	Abbey View Lodges Orchard House 105 Abbey Road Leiston Suffolk IP16 4TA	Redevelopment of the site for eight dwellings.	16/08/2017	Construction commenced	24

12.4.46 The construction timeline for these committed developments is unconfirmed. However, planning permissions generally require construction to commence within three years of the grant of planning permission or reserved matters approval before the planning permission lapses. As such, and for the

purposes of this assessment, it has been assumed that the developments will have been constructed prior to 2022. These committed developments have therefore been considered as future receptors as part of the baseline for the groundwater and surface water assessments.

12.4.47 There is not anticipated to be any change to aquifer classification as a result of any stage of the development.

12.4.48 As the length of the construction, operational and removal and reinstatement phases of the proposed development will cover a 9-12 year period, changes to the Water Framework Directive status of the Leiston Beck and Hundred River Water Bodies could be realised, relating to the default 'good status' been achieved by 2027 and beyond. Although Water Framework Directive status is only relevant to the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14). By-products, such as improved water quality, geomorphology or biology as a result of Water Framework Directive implementation should be considered within the evolution of the future baseline.

12.4.49 The future baseline of the Leiston Beck Water Body from a Water Framework Directive perspective does not envisage any change to the status of the water body as a result of the proposed development. Factors confirming that the existing ecological qualities of the Leiston Beck will be maintained as the future baseline include:

- the Leiston Beck already supports good hydromorphological elements, thus this quality cannot be improved; and
- the physico-chemical quality of the Leiston Beck will remain Moderate due the continued consented discharge from the Leiston water recycling centre, meaning phosphate levels within the system will remain elevated and dissolved oxygen will remain low.

12.4.50 Due to the moderate physico-chemical quality status that is not anticipated to change, the ecological status of the Leiston Beck will remain as moderate throughout the construction, operation and removal and reinstatement phases of the proposed development.

12.4.51 The future baseline of the Hundred River Water Body from a Water Framework Directive perspective does not envisage any change to the status of the water body as a result of the proposed development. Factors confirming that the existing ecological qualities of the Hundred River will be maintained as the future baseline include:

- the unfavourable balance of costs to improve the status of phosphate, which is currently moderate;

- no technical solution is available to improve the status of dissolved oxygen, which is currently bad; and
- no technical solution is available to improve the status of fish, which is currently bad.

12.4.52 Due to the moderate physico-chemical quality status and bad biological quality status that is not anticipated to change, the ecological status will remain as moderate throughout the construction, operation and removal and reinstatement phases of the proposed development.

12.5 Environmental design and mitigation

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

12.5.2 The assessment of likely significant effects of the proposed rail extension route assumes that primary and tertiary mitigation measures are in place. For amenity and recreation, these measures are identified below, with a summary provided on how the measures contribute to the mitigation and management of potentially significant environmental effects.

12.5.3 For groundwater and surface water the following primary and tertiary mitigation measures have been embedded into the design and construction management of the proposed development.

a) Primary mitigation

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

i. Construction phase

12.5.5 No primary mitigation measures are embedded for the construction phase.

ii. Operational phase

12.5.6 A drainage strategy will be incorporated into the design of the proposed development that will accommodate drainage from both sides of the track and any overland flow which is interrupted when the track is in cutting, at grade or on an embankment. Active management and maintenance of the

drainage infrastructure is required to ensure the continued efficacy of the drainage system.

12.5.7 The proposed drainage system would incorporate SuDS measures as set out in the **Outline Drainage Strategy,** provided in **Appendix 2A** of **Volume 2** of the **ES**, such as swales and bypass separators where appropriate. The proposed works will not significantly increase the impermeable area of ground cover at the site as the material used for the railway line will be highly permeable, allowing the infiltration to groundwater. The drainage design will intercept run-off from adjacent areas, avoiding flooding of lengths of the railway that are in cutting and preventing increased run-off to adjacent areas where the railway is embanked. This design will avoid and minimise impacts to surface water receptors.

iii. Removal and reinstatement

12.5.8 The removal of the proposed development would include the removal of any related drainage and SuDS measures and infrastructure within the site. Any control measures used to protect groundwater and surface water during the construction phase would also be applied during the removal and reinstatement phase.

b) Tertiary mitigation

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

12.5.10 The drainage/flood prevention strategies will consider the ground conditions of the site, including the permeability of the strata and the level of on-site contamination.

12.5.11 Groundwater management during the construction phase may be required to dewater the area immediately adjacent to the cutting, should groundwater be locally present. These groundwater control measures will be developed at detailed design stage following ground investigation.

12.5.12 Tertiary mitigation measures to be incorporated into the proposed development during enabling works, construction, operation and the removal and reinstatement phases of the proposed rail extension route, as set out in the **Code of Construction Practice** (**CoCP**) (Doc Ref. 8.11) include:

- A temporary sustainable drainage system (SuDS) to be implemented early in the construction phase. Construction phase measures to intercept surface run off, sediment and contaminants from the construction compounds and laydown areas, and incorporate

sustainable drainage measures such as swales, filter drains and infiltration basins to promote infiltration.

- Construction drainage to be contained within the site, with infiltration to ground. A low bund is proposed to be constructed to achieve this with an external toe drain to intercept off-site run-off that may otherwise be impeded by the presence of the proposed bund. Only if full infiltration is not possible, would these systems discharge into existing surface drainage networks at greenfield run-off rates to minimise the potential for impact.

- Hardstanding to be constructed within the construction compounds where required to mitigate potential spills and leaks. Water falling onto impermeable surfaces to pass through a bypass separator.

- Foul sewage arising on site during construction to be tankered off site.

- Implementation of working methods during construction to ensure there would be no surface water run-off from the works, or any stockpiles, into adjacent surface watercourses/leaching into underlying groundwater in accordance with best practice.

- Implementation of appropriate pollution incident control for example plant drip trays and spill kits. Spill kits would be available on site at all times. Sand bags or stop logs would also be available for deployment on the outlets from the site drainage system in case of emergency spillages.

- Implementation of appropriate and safe storage of fuel, oils and equipment during construction, for example all fuels, oils, lubricants and other chemicals would be stored in an impermeable bund with at least 110% of the stored capacity. All refuelling would take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils should be used where possible.

- The wheels of all vehicles would be free of contamination before arriving at site. All vehicles would be inspected prior to leaving site and should contaminative substances be identified suitable measures (e.g. wheel washing) would be implemented.

- Concrete and cement mixing and washing areas would be situated at least 10m away from existing surface water receptors. These would incorporate settlement and recirculation systems to allow water to be

re-used. All washing out of equipment would be undertaken in a contained area, and all water would be collected for off-site disposal.

- Stockpiles would be located a minimum of 10m from the nearest watercourse.

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

- Excavation and handling of materials and stockpiling, and construction waste, would be managed by good working practice in accordance with the materials management measures, soil management measures and waste management measures set out in the **CoCP** (Doc Ref. 8.11).

12.6 Assessment

a) Introduction

12.6.1 This section presents the findings of the groundwater and surface water assessment for the construction and operation of the proposed rail extension route.

12.6.2 This section identifies any likely significant effects that are predicted to occur and **section 12.7** of this chapter then highlights any secondary mitigation and monitoring measures that are proposed to minimise any adverse significant effects (if required).

12.6.3 As identified in **section 12.3** of this chapter, the Saxmundham to Leiston branch line upgrades and associated level crossings upgrades are not considered likely to result in significant environmental effects during their construction or operation.

b) Construction

i. Groundwater level and flow regime

12.6.4 The removal of on-site vegetation and the compaction of soils due to construction vehicles and materials storage may locally reduce the rate at which rainfall makes its way into the groundwater for a short duration, however, the volume of water discharging to ground is unlikely to change. The impact to groundwater from these activities would be very low, resulting in a negligible effect for the very low and low value superficial aquifers and a minor adverse effect for the medium value Crag aquifer. The effect would be **not significant**.

12.6.5 The construction would include a section of cutting of up to 3.2m bgl, with a minimum elevation of +10.50m AoD. The 2014 Structural Soils ground investigation, as detailed in **Appendix 18A** of **Volume 2** of the **ES,** provided borehole logs within the vicinity of the cutting. Based on the information in these logs, it is unlikely that the cutting will extend beyond the base of the low permeability Lowestoft Formation (diamicton) aquifer and into the underlying Crag aquifer. Groundwater level monitoring within the vicinity of the cutting has established a peak groundwater level of +13.04m AoD within the Lowestoft Formation (diamicton) aquifer. Due to the limited lateral extent of groundwater within the Lowestoft Formation (diamicton), it is likely that any groundwater control measures required to dewater the superficial aquifer during the construction of the cutting would be localised and of short duration. The impact to the very low value Lowestoft Formation (diamicton) aquifer would be low and the effect classified as negligible. The effect would be **not significant**.

12.6.6 It is unlikely that the base of the cutting will extend beyond the base of the Lowestoft Formation (diamicton) aquifer. Therefore, no groundwater control measures are anticipated to be required within the Lowestoft Formation sand and gravels aquifer or the Crag aquifer and there would be **no effect** on these aquifers with respect to dewatering activities.

12.6.7 Based on the information available, all of the groundwater abstractions within the outer study area abstract water from the underlying Crag or Lowestoft Formation sand and gravel aquifers. No groundwater level control measures are anticipated for these aquifers and due to the distance of the abstractions from the site at greater than 250m, with the implementation of the primary and tertiary mitigation measures identified, it is unlikely that they will be affected by any local changes to the hydrogeological environment from the construction activities. It is concluded that there would be no effect on the abstractions with respect to water level and flow.

12.6.8 There are no known PWS in the outer study area, however, groundwater control measures are anticipated to be confined to the Lowestoft Formation (diamicton), from which it is unlikely that PWS would abstract water. It is concluded that there would be no effect on PWS in the outer study area with respect to groundwater level and flow.

12.6.9 Due to the anticipated localised and short-term groundwater control requirements at the site, it is concluded that there would be no effect on the medium value existing buildings in terms of subsidence risk.

ii. Contamination of groundwater

12.6.10 As presented in **Chapter 11** of this volume and its appendices, the construction phase would potentially introduce new sources of contamination

to the site through spills or leaks of contaminants used during construction. Construction works, such as excavation and stockpiling, can pose a risk to groundwater receptors through leaching and run-off of contaminants. Intrusive activities and removal of low permeability material can pose a risk to groundwater by creating new contaminant pathways or mobilising existing contamination through exposure of contaminated soil or remobilisation of contaminants through soil disturbance. The potential contaminant linkages assessed in **Chapter 11** of this volume which have been carried forward into this assessment are:

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

12.6.11 As presented in **Chapter 11** of this volume and its appendices, there is the potential for existing contamination at the site, as well as the introduction of new contaminants and preferential pathways through construction activities. The implementation of the primary and tertiary mitigation measures identified in **section 12.5** of this chapter and in **Chapter 11** of this volume, including implementation of pollution incident control and safe storage of fuel, oils and equipment, would reduce this risk.

12.6.12 Earthwork activities, such as cutting creation, during the construction process create a potential pathway for existing on-site contamination to reach groundwater. Based on the available GI information, it is unlikely that the cutting will extend beyond the base of the low permeability Lowestoft Formation (diamicton) aquifer and into the underlying Crag aquifer. It is therefore likely that should contamination be introduced it will be confined to the superficial aquifer.

12.6.13 The Crag groundwater would be protected from any spills or leaks where it is overlain by low permeability superficial deposits, however, in areas where the Crag is overlain by sand and gravel of the Lowestoft Formation there is a potential pathway for contamination to reach the Crag groundwater.

12.6.14 If a spill or leak does occur, given the relatively low volumes of potentially contaminative material and the primary and tertiary mitigation measures employed, the scale of any spill or leak is likely to be small.

12.6.15 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the leaching/migration of contaminants through the soil is slightly increased during the construction phase and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.16 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the migration of contaminants through preferential pathways created by the construction activities is slightly increased during the construction phase and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.17 The groundwater abstractions in the inner study area are all located more than 250m from the site. Given the extent and depth of the low permeability superficial deposits across the site and its confining nature, with the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstraction is as for the aquifer from which it abstracts groundwater. This is a slight increase from baseline risk during the construction activities and the effect is classified as minor adverse. The effect would be **not significant**.

12.6.18 There are no known PWS in the inner study area, however there is the potential for as yet unidentified PWS to be within the inner study area. With the implementation of the primary and tertiary mitigation measures identified, the impact to potential PWS with respect to water quality beyond the site itself would be the same as for the groundwater from which they would abstract and therefore classified as minor adverse. The effect would be **not significant**.

12.6.19 It is considered that there is no pathway for contaminative sources from the construction activities to impact groundwater receptors beyond the inner study area of 500m. Groundwater receptors identified in the baseline environment **section 12.4** of this chapter which are situated outside of the inner study area are therefore not assessed for the effects from contaminative sources during the construction phase.

12.6.20 Further risks from existing on-site contamination are discussed in further detail in **Chapter 11** of this volume.

iii. Contamination of surface waters

12.6.21 It is considered that there is a pathway for contaminative sources from the construction activities to impact surface water receptors beyond the inner

study area of 500m. Surface water receptors identified in the baseline environment **section 12.4** of this chapter which are situated in the outer study area are therefore assessed for the effects from contaminative sources during the construction phase.

12.6.22 Contamination of surface waters arising from construction activities through the disturbance/mobilisation of existing sources of contamination or the introduction of new sources/contaminants have the potential to adversely affect the water quality of the Leiston drain and Hundred River, existing drainage network, the ponds within the inner study area and the surface water abstraction.

12.6.23 Where excavations and the introduction of contaminants to a site take place, there is the potential for an increase in the risk of contaminating the nearest receptor. The proposed development would involve excavations and therefore has the potential mobilise and introduce contaminants during the construction phase.

12.6.24 Temporary SuDS would be implemented early in the construction phase. The site would be isolated from the wider environment until the SuDS are operational. The creation of a surface water management system will intercept surface run-off, sediment and contaminants from the construction compounds and laydown areas. Implementation of appropriate pollution incident control in accordance with the **CoCP** (Doc Ref. 8.11) would further minimise the impacts of site construction activities on the receptors.

12.6.25 As detailed in **Appendices 11B** and **11C** of this volume, the risk on the existing drainage network, the River Hundred and the Leiston drain and the ponds within the inner study area from both lateral migration of existing contamination and discharge of contaminants from construction activities is considered to increase compared to the baseline risk. The effects from both impacts on these surface water receptors are classified as minor adverse and considered to be **not significant**.

12.6.26 Contamination of surface waters arising from construction activities also have the potential to affect the existing surface water abstraction within the outer study area. Based on the protection afforded by primary and tertiary mitigation measures, the effect is classified as minor adverse and considered to be **not significant**.

iv. Flood risk

12.6.27 During construction, a temporary SuDS would be constructed for the site. This drainage system would retain surface water run-off within the site and enable infiltration. As the majority of the site is located in Flood Zone 1, construction activities will not lead to a loss in functional floodplain storage or displacement of sea or river flood water. No significant effect is predicted.

12.6.28 Further information on flood risk at the site is provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) which has been submitted as part of application for development consent.

v. WFD compliance

12.6.29 The site is located within the Leiston Beck and Hundred River Water Framework Directive water body catchments and on the Waveney and East Suffolk Chalk and Crag groundwater body. The Hundred River water body was screened out of the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) because the proposed activities would be confined to a very small proportion of the water body catchment (0.016km^2, 0.06%), are located on the watershed and are not connected to any identified flow paths that connect to the drainage network.

12.6.30 The **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) demonstrates that proposed construction activities would not have direct or indirect effects on the Leiston Beck and Waveney and East Suffolk Chalk and Crag water bodies that would be sufficient to cause deterioration in the status of the water body or Protected Areas located within the water bodies.

12.6.31 As the proposed construction activities will not lead to a change in the overall status of the water bodies; the proposed construction activities are deemed compliant with the WFD.

12.6.32 Further information on WFD compliance is provided in the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14), which has been submitted as part of application for development consent.

vi. Inter-relationship effects

12.6.33 This section provides a description of the identified inter-relationship effects that are anticipated to occur on groundwater and surface water receptors between the individual environmental effects arising from construction of the proposed development.

12.6.34 There are anticipated to be inter-relationship effects between groundwater and surface water (i.e. groundwater providing baseflow to surface watercourses); geology and land quality (i.e. naturally elevated concentration of contaminants in certain geologies); and terrestrial ecology and ornithology (i.e. groundwater dependent ecosystems). This is in relation to potential receptors which could be impacted during the construction of the proposed development.

12.6.35 The assessment of groundwater and surface water flows and levels is considered in this chapter and there are no further combined effects beyond those stated in the preceding section.

12.6.36 The assessment of contamination of groundwater and surface water is considered inherently within the geology and land quality assessment, as detailed in **Chapter 11** of this volume, and no further combined effects are anticipated.

12.6.37 The assessment of terrestrial ecology is considered in **Chapter 7** of this volume.

c) Operation

i. Groundwater level and flow regime

12.6.38 Instances where cuttings intercept the water table could have an impact on the groundwater level and flow direction, although long-term groundwater control would unlikely be required given the limited lateral extent of groundwater within the Lowestoft Formation (diamicton), and the depth to the Crag aquifer which is unlikely to be intercepted by the cutting. The potential impact to groundwater levels in the aquifers and to existing buildings from the proposed development with respect to subsidence risk does not require further assessment.

12.6.39 The drainage design would intercept run-off from adjacent areas, avoiding flooding of lengths of the railway that are in cutting and preventing increased run-off to adjacent areas where the railway is in a cutting, at grade or on an embankment. This design would avoid, or minimise, impacts to groundwater receptors.

12.6.40 The material used for the rail extension route would be highly permeable, allowing infiltration to groundwater. This would mean that although the spatial distribution of infiltration would be altered, the total volume of infiltration entering the ground would not be substantially changed. The impact to the very low and low value superficial aquifers would therefore be of long-term, low magnitude and the effect classified as negligible for the diamicton deposits and minor adverse for the sand and gravels of the Lowestoft Formation. The effect would be **not significant**.

12.6.41 The Crag is predominantly overlain by the low permeability Lowestoft Formation (diamicton) aquifer, however, changes to the distribution of recharge over the site area may have an effect on the flow regime of the Crag groundwater under the site. The impact on the medium value Crag aquifer would therefore be very low, and the effect on the flow regime of the Crag aquifer is classified as minor adverse. The effect would be **not significant**.

12.6.42 Groundwater abstraction is assumed to be either within the Crag aquifer, or the sand and gravel of the Lowestoft Formation. Due to the relatively small changes in the groundwater flow and level regime, in combination with the implementation of the primary and tertiary mitigation measures identified, it is unlikely that they would be affected by any local changes to the hydrogeological environment. It is, therefore, concluded that there will be no effect on the groundwater abstractions with respect to groundwater level and flow.

12.6.43 Whilst there are no known PWS in the outer study area, the superficial and bedrock aquifers are anticipated to experience very little impact from the development. The impact on any medium value PWS would be very low and the effect would be classified as minor adverse. The effect would be **not significant**.

ii. Contamination of groundwater

12.6.44 As presented in **Chapter 11** of this volume and its appendices, the operation of the proposed development could introduce new sources of contamination to the site and create additional potential pathways for the migration of potential contamination. The implementation of the primary and tertiary mitigation measures identified in **section 12.5** of this chapter and in **Chapter 11** of this volume, would reduce this risk.

12.6.45 During operation the main risks from contamination are fuel spills or leaks from the trains using the proposed development. It is understood that contamination from these sources would be of limited magnitude and longevity and would be mitigated through tertiary mitigation methods. It is therefore considered that the operation of the proposed development will have no significant impact on groundwater quality. The presence of bypass separators within the drainage design (subject to hazard assessment alongside the detailed design) would prevent the supply of sediment and other contamination to the drainage network. The provision of swales and infiltration ponds for areas of impermeable surface cover would protect the underlying groundwater from hydrocarbon contamination.

12.6.46 As presented in **Chapter 11** of this volume and its appendices, there is the potential for contamination sources and the existing contamination on the site, compared to the existing baseline, the level of risk to receptors remains the same or slightly decreased.

12.6.47 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the leaching/migration of contaminants through the soil is slightly decreased during the operation phase and the effect is classified as minor beneficial. The effects would be **not significant**.

12.6.48 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the migration of contaminants through preferential pathways created by the operational activities is slightly decreased during the operation phase and the effect is classified as minor beneficial. The effects would be **not significant**.

12.6.49 The groundwater abstractions identified are located over 250m from the site. Given the extent and depth of the low permeability superficial deposits across the site and its confining nature, with the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstraction is as for the aquifer from which it abstracts groundwater. This is a decrease in risk from baseline during the operation activities and the effect is classified as minor beneficial. The effect would be **not significant**.

12.6.50 There are no known PWS in the inner study area. With the implementation of the primary and tertiary mitigation measures identified, the impact on any PWS with respect to water quality would be the same as for the groundwater from which they would abstract and therefore the effect would be classified as minor beneficial. The effect would be **not significant**.

12.6.51 It is considered that there is no pathway for contaminative sources from the operational activities to impact groundwater receptors beyond the inner study area of 500m. Groundwater receptors identified in the baseline environment **section 12.4** of this chapter which are situated outside of the inner study area are therefore not assessed for the effects from contaminative sources during the operation phase.

iii. Contamination of surface waters

12.6.52 It is considered that there is a pathway for contaminative sources from the operational activities to impact surface water receptors beyond the inner study area of 500m. Surface water receptors identified in the baseline environment **section 12.4** of this chapter which are situated in the outer study area are therefore assessed for the effects from contaminative sources during the operation phase.

12.6.53 Contamination of surface waters may arise from the operation of the proposed development due to the introduction of new sources of contaminants or the disturbance and mobilisation of existing sources of contamination. If this occurs, these have the potential to adversely affect the water quality of the Leiston drain and Hundred River, existing drainage network, ponds within the inner study area and the surface water abstraction.

12.6.54 The design of the rail extension route will incorporate an operational drainage system which would incorporate SuDS measures where appropriate. Appropriate pollution incident controls will be implemented.

12.6.55 As detailed in **Appendices 11B** and **11C** of this volume, on the basis of the primary and tertiary mitigation measures being implemented, the risk on surface waters would remain the same as the baseline risk. The effects from lateral migration and discharge of contaminants on these surface water receptors are classified as negligible and considered to be **not significant**.

12.6.56 On the basis of the implementation of the primary and tertiary mitigation measures, the effect is classified as negligible and considered to be **not significant**.

iv. Alteration of effective land drainage

12.6.57 The proposed development has the potential to undermine the wider drainage network, a very low sensitivity receptor. Traditional drainage will be used parallel to the proposed rail extension route to maintain land drainage of adjacent areas.

12.6.58 A very low magnitude impact is predicted, which will have a negligible effect on the wider drainage network and would be **not significant**.

v. Flood risk

12.6.59 The site is located in Flood Zone 1, meaning that there will be no loss in functional floodplain storage or displacement of sea or river flood water as a result of the proposed development. The proposed development will not, therefore, increase flood risk to surrounding areas.

12.6.60 The increase in impermeable area associated with the proposed development will require sustainable management of surface water run-off through the attenuation and controlled discharge of flows to the surrounding environment, most likely infiltration to ground. These mitigation measures have been designed to ensure that there are no adverse effects from the existing surface water flood risk identified on part of the site. The proposed development is classed as being 'Essential Infrastructure' under the NPPF. The rail extension route is considered appropriate in terms of flood risk vulnerability and, therefore, passes the Sequential Test. Following mitigation, the proposed development is considered to be appropriate in terms of flood risk under the NPPF guidance the development site is considered to be appropriate in terms of flood risk. No effect is predicted.

12.6.61 Further information on flood risk at the site is provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) which has been submitted as part of this application for development consent.

vi. WFD compliance

12.6.62 The site is located within the Leiston Beck and Hundred River WFD water body catchments and on the Waveney and East Suffolk Chalk and Crag groundwater body. The Hundred River water body was screened out of the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14).

12.6.63 The **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) demonstrates that proposed operational activities would not have direct or indirect effects on the Leiston Beck and Waveney and East Suffolk Chalk and Crag water bodies that would be sufficient to cause deterioration in the status of the water body or Protected Areas located within the water bodies.

12.6.64 Furthermore, the proposed operational activities would not counteract or otherwise affect the delivery of the mitigation or improvement measures that have been identified in the RBMP for these water bodies.

12.6.65 As the proposed operational activities will not lead to a change in the overall status of the water bodies; the proposed operational activities are deemed compliant with the Water Framework Directive.

12.6.66 Further information on Water Framework Directive compliance is provided in the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) which has been submitted as part of application for development consent.

vii. Inter-relationship effects

12.6.67 This section provides a description of the identified inter-relationship effects that are anticipated to occur on groundwater and surface water receptors between the individual environmental effects arising from operation of the proposed development.

12.6.68 There are anticipated to be inter-relationship effects between groundwater and surface water (i.e. groundwater providing baseflow to surface watercourses); geology and land quality (i.e. naturally elevated concentration of contaminants in certain geologies); and terrestrial ecology and ornithology (i.e. groundwater dependent ecosystems). This is in relation to potential receptors which could be impacted during the operation of the proposed development.

12.6.69 The assessment of groundwater and surface water flows and levels is considered in this chapter and there are no further combined effects beyond those stated in the preceding section.

12.6.70 The assessment of contamination of groundwater and surface water is considered inherently within the geology and land quality assessment, as detailed in **Chapter 11** of this volume, and no further combined effects are anticipated.

12.6.71 The assessment of terrestrial ecology is considered in **Chapter 7** of this volume.

d) Removal and reinstatement

i. Groundwater level and flow regime

12.6.72 The proposed rail extension route would be removed and re-instated to existing conditions, except the relocated junction of the B1122 (Abbey Road) and Lover's Lane which would remain in place. The removal of the proposed rail extension route and compaction of soils may locally reduce the rate at which rainfall makes its way into the groundwater for a short duration, however, the overall volume of water discharging to ground is unlikely to change. The impact to groundwater from these activities would be localised and very low, resulting in a negligible effect for the very low and low value superficial aquifers and a minor adverse effect for the medium value Crag aquifer. These effects would be **not significant.**

12.6.73 Due to the nature of the removal and reinstatement works, it has been assumed that groundwater in the underlying aquifers would not be encountered during the removal and reinstatement phase and therefore groundwater dewatering control measures would not be required during the removal and reinstatement of the proposed development. Therefore, there is no potential impact to groundwater levels, and to existing buildings, from the proposed development with respect to subsidence risk.

ii. Contamination of groundwater

12.6.74 As presented in **Chapter 11** of this volume and its appendices, the removal and reinstatement of the proposed development could introduce new sources of contamination to the site and create additional potential pathways for the migration of potential contamination. Intrusive activities and removal of the rail extension route and low permeability material can pose a risk to groundwater by creating new contaminant pathways or mobilising existing contamination through exposure of contaminated soil or remobilisation of contaminants through soil disturbance. The implementation of the primary and tertiary mitigation measures identified in **section 12.5** of this chapter and in **Chapter 11** of this volume, would reduce this risk.

12.6.75 The Crag groundwater would be protected from any spills or leaks where it is overlain by low permeability superficial deposits. However, in areas where

the Crag is overlain by sand and gravel of the Lowestoft Formation there is a potential pathway for contamination to reach the Crag groundwater.

12.6.76 If a spill or leak does occur, given the relatively low volumes of potentially contaminative material and the primary and tertiary mitigation measures employed, the scale of any spill or leak is likely to be small.

12.6.77 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the leaching/migration of contaminants through the soil is slightly increased during the removal and reinstatement phase and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.78 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the migration of contaminants through preferential pathways created by the removal and reinstatement activities is slightly increased during the removal and reinstatement phase and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.79 The groundwater abstractions in the inner study area are all located more than 250m from the site. Given the extent and depth of the low permeability superficial deposits across the site and its confining nature, with the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstraction is as for the aquifer from which it abstracts groundwater. This is a slight increase from baseline during the removal and reinstatement activities and the effect is classified as minor adverse. The effect would be **not significant**.

12.6.80 There are no known PWS in the inner study area, however there is the potential for as yet unidentified PWS to be within the inner study area. With the implementation of the primary and tertiary mitigation measures identified, the impact to potential PWS with respect to water quality beyond the site itself is as for the aquifer from which it abstracts groundwater and classified as minor adverse. The effect would be **not significant**.

12.6.81 It is considered that there is no pathway for contaminative sources from the removal and reinstatement activities to impact groundwater receptors beyond the inner study area of 500m. Groundwater receptors identified in the baseline environment **section 12.4** of this chapter which are situated outside of the inner study area are therefore not assessed for the effects from contaminative sources during the removal and reinstatement phase.

iii. Contamination of surface waters

12.6.82 It is considered that there is a pathway for contaminative sources from the removal and reinstatement activities to impact surface water receptors

beyond the inner study area of 500m. Surface water receptors identified in the baseline environment set out in **section 12.4** of this chapter which are situated in the outer study area are therefore assessed for the effects from contaminative sources during the removal and reinstatement phase.

12.6.83 Contamination of surface waters arising from removal and reinstatement activities through the disturbance/mobilisation of existing sources of contamination or the introduction of new sources/contaminants have the potential to adversely affect the biology and water quality of the Leiston drain and Hundred River and existing drainage network, the ponds within the inner study area and the surface water abstraction.

12.6.84 Where excavations and the introduction of contaminants to a site take place, there is the potential for an increase in the risk of contaminating the nearest receptor. The excavations required would have the potential to introduce contaminants during the removal and reinstatement phase.

12.6.85 The site would be isolated from the wider environment until the removal and restoration works have ceased. Implementation of appropriate pollution incident control in accordance with the **CoCP** (Doc Ref. 8.11) will further minimise the impacts of site construction activities on the surface drainage network.

12.6.86 As detailed in **Appendices 11B** and **11C** of this volume, the risk on the existing drainage network, the River Hundred and the Leiston drain and ponds within the inner study area from both lateral migration of existing contamination and discharge of contaminates from demolition and landscaping activities is considered to slightly increase compared to the baseline risk. The effects from both impacts on these surface water receptors are classified as minor adverse and considered to be **not significant**.

12.6.87 Contamination of surface waters arising from removal and reinstatement activities also have the potential to affect the existing surface water abstraction within the outer study area. Based on the protection afforded by primary and tertiary mitigation measures, the effect is classified as minor adverse and considered to be **not significant**.

iv. Flood risk

12.6.88 As the site is located in Flood Zone 1, removal and reinstatement activities will not lead to a loss in functional floodplain storage or displacement of sea or river flood water.

12.6.89 Once the operation of the proposed development has ceased, the site would be returned to its original agricultural use, except where the junction of the B1122 (Abbey Road) and Lover's Lane which would remain in place is

relocated to. This would include the removal of any related drainage and SuDS measures. The removal of the proposed development and reinstatement of the site is considered to be appropriate in terms of flood risk. No effect is predicted.

12.6.90 Further information on flood risk at the site is provided in the **Rail Flood Risk Assessment** (Doc Ref. 5.9) which has been submitted as part of this application for development consent.

v. WFD compliance

12.6.91 The site is located within the Leiston Beck and Hundred River Water Framework Directive water body catchments and on the Waveney and East Suffolk Chalk and Crag groundwater body. The Hundred River water body was screened out of the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14).

12.6.92 The **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) demonstrates that proposed removal and reinstatement activities would not have direct or indirect effects on the Leiston Beck and Waveney and East Suffolk Chalk and Crag water bodies that would be sufficient to cause deterioration in the status of the water body or Protected Areas located within the water bodies.

12.6.93 As the proposed removal and reinstatement activities will not lead to a change in the overall status of the water bodies; the proposed removal and reinstatement activities are deemed compliant with the Water Framework Directive.

12.6.94 Further information on Water Framework Directive compliance is provided in the **Water Framework Directive Compliance Assessment Report** (Doc Ref. 8.14) which has been submitted as part of application for development consent.

vi. Inter-relationship effects

12.6.95 This section provides a description of the identified inter-relationship effects that are anticipated to occur on surface water and groundwater receptors between the individual environmental effects arising from the removal and site restoration phase of the proposed development.

12.6.96 There are anticipated to be inter-relationship effects between groundwater and surface water (i.e. groundwater providing baseflow to surface watercourses); geology and land quality (i.e. naturally elevated concentration of contaminants in certain geologies); and terrestrial ecology and ornithology (i.e. groundwater dependent ecosystems). This is in relation to potential

receptors which could be impacted during the removal and reinstatement of the proposed development.

12.6.97 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment and no further combined effects are anticipated.

12.6.98 The assessment of groundwater and surface water flows and levels is considered in this chapter and there are no further combined effects beyond those stated in the preceding section.

12.6.99 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment, as detailed in **Chapter 11** of this volume, and no further combined effects are anticipated.

12.6.100 The assessment of terrestrial ecology is considered in **Chapter 7** of this volume.

12.7 Mitigation and monitoring

12.7.1 Where possible, mitigation measures have been proposed where a significant effect is predicted to occur. Primary and tertiary mitigation measures which have already been accounted for as part of the assessment are summarised in **section 12.5** of this chapter. Where further mitigation is required, this is referred to as secondary mitigation.

12.7.2 This section describes the proposed secondary mitigation measures for groundwater and surface water as well as describing any monitoring required of specific receptors/resources or for the effectiveness of a mitigation measure. The requirements, scope, frequency and duration of a given monitoring regime are set out, as far as possible.

a) Mitigation

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

12.7.4 Intrusive GI would also be undertaken post operation of the proposed rail extension route as part of the removal and reinstatement phase. This ground

investigation would confirm the ground conditions, contamination status and other ground related risks at the site following the operational phase

12.7.5 Remediation of soil or ground contamination would be undertaken during this phase if deemed necessary.

12.7.6 Active management and maintenance of the drainage infrastructure would be required during the operational phase to ensure the continued efficacy of the drainage network.

12.7.7 A flood risk emergency plan would be developed to identify safe access and escape routes, demonstrate free and safe movement of people during a design flood and set out the potential for evacuation before a more extreme event.

b) Monitoring

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

12.7.9 Implementation of a contamination watching brief by suitably qualified and experienced personnel would be completed for proposed development when excavating areas of potential contamination risk.

12.8 Residual effects

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

Table 12.11: Summary of effects for the construction phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Crag groundwater (Principal Aquifer, SPZ2 and SPZ3).	Reduction in the rate/volume of water discharging to ground.	Temporary SuDS and water management zones. Ensuring all site activities	Minor adverse.	GI and relevant risk assessments. Remediation of soil and groundwater if necessary.	Minor adverse **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	Migration of contamination through preferential pathways to groundwater.	are carried out in accordance with the **CoCP** (Doc Ref. 8.11).	Minor adverse.	Longer term gas and groundwater monitoring if necessary.	Minor beneficial **(not significant)**.
Lowestoft Formation sands and gravels groundwater (Secondary A Aquifer).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Lowestoft Formation (diamicton) groundwater (Secondary Aquifer (un-differentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Localised reduction in groundwater level and flow regime of the aquifer during dewatering to facilitate the construction of the rail extension route cutting.		Negligible		Negligible **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Groundwater abstractions identified within	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
500m of the site boundary.	Contamination mobilised during construction migrating to the abstraction.		Minor adverse.		Minor beneficial **(not significant)**.
Groundwater abstractions identified between 500m and 1km of the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.
	Contamination mobilised during construction migrating to the abstraction.		No effect.		No effect **(not significant)**.
Potential PWS.	Reduction in groundwater availability to the PWS.		Minor adverse.		Minor adverse **(not significant)**.
	Contamination mobilised during construction migrating to the PWS.		Minor adverse.		Minor beneficial **(not significant)**.
Existing buildings.	Groundwater control measures attributing to subsidence risk.		No effect.		No effect **(not significant)**.
Leiston drain (Main River).	Contamination of the watercourse.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Adoption of pollution prevention measures.	Minor adverse.	GI and risk assessment. Remediation of soil and surface water receptor if necessary.	Minor beneficial **(not significant)**.
Hundred River (Main River).	Contamination of the watercourse.		Minor adverse.		Minor beneficial **(not significant)**.
Existing drainage network.	Contamination of the controlled waters.		Minor adverse.		Minor beneficial **(not significant)**.
Ponds within the inner study area.	Contamination of the ponds.		Minor adverse.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Surface water abstraction.	Contamination of the source.		Minor adverse.		Minor beneficial **(not significant)**.
Flood risk to surrounding areas	Loss of functional floodplain storage or displacement of sea or river water.	Swales will be incorporated into the design.	No effect.	Not required.	No effect **(not significant)**.

Table 12.12: Summary of effects for the operational phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Crag groundwater (Principal Aquifer, SPZ2 and SPZ3).	Reduction in the rate/volume of water discharging to ground.	Water draining from the site will pass through appropriate drainage, including the incorporation of SuDS and petrol/oil interceptors where necessary. This will allow infiltration to the superficial aquifer, whilst also protecting the underlying groundwater from hydrocarbon contamination.	Minor adverse.	GI and risk assessment. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary. Management and maintenance of the SuDS.	Minor adverse **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Lowestoft Formation sands and gravels groundwater (Secondary A Aquifer).	Reduction in the rate/volume of water discharging to ground.		Minor adverse.		Minor adverse **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Lowestoft Formation (diamicton) groundwater (Secondary Aquifer (un-differentiated))	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial **(not significant)**.
Groundwater abstractions identified within 500m of the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.
	Contamination mobilised during operation migrating to the abstraction.		Minor beneficial.		Minor beneficial **(not significant)**.
Groundwater abstractions identified between 500m and 1km of the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.
	Contamination mobilised during operation migrating to the abstraction.		No effect.		No effect **(not significant)**.
Potential PWS.	Reduction in groundwater availability to the PWS.		Minor adverse.		Minor adverse **(not significant)**.
	Contamination mobilised during operation migrating to the PWS.		Minor adverse.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Leiston drain (Main River).	Chemical spills or leaks.	The operational drainage system would incorporate SuDS measures where appropriate, to minimise potential impacts on surface water receptors.	Negligible	GI and risk assessment. Remediation of soil and surface water receptor if necessary. Active management and maintenance of the SuDS to maximise efficacy.	Negligible **(not significant)**.
Hundred River (Main River).	Chemical spills or leaks.		Negligible		Negligible **(not significant)**.
Existing drainage network within the site.	Chemical spills or leaks.		Negligible		Negligible **(not significant)**.
	Alteration of drainage networks.	Traditional drainage along the rail extension route to maintain land drainage of adjacent areas.	Negligible.		Negligible **(not significant)**.
Ponds within the inner study area.	Contamination of the ponds.	The operational drainage system would incorporate SuDS measures where appropriate, to minimise potential impacts on surface water receptors.	Negligible		Negligible **(not significant)**.
Surface water abstraction.	Contamination of the source.		Negligible		Negligible **(not significant)**.
Flood risk to surrounding areas.	Loss of functional floodplain storage or displacement of sea or river water.	Swales will be incorporated into the design.	No effect.	Not required.	No effect **(not significant)**.

Table 12.13: Summary of effects for the removal and reinstatement phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Crag groundwater (Principal Aquifer, SPZ2 and SPZ3).	Reduction in the rate/volume of water discharging to ground.	Appropriate drainage design. Remediation of on-site contamination required.	Minor adverse.	GI and relevant risk assessments completed prior to detailed design.	Minor adverse **(not significant)**.
	Leaching/migration of contamination in		Minor adverse.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	soils to groundwater.	Ensuring all site activities are carried out in accordance with the **CoCP** (Doc Ref. 8.11).		Remediation and mitigation prior to construction as necessary. Further GI and risk assessment post operation to confirm the risks at the time of removal and reinstatement and identify areas requiring further remediation. Remediation of soil and groundwater due to incident occurring during the operational phase if necessary.	
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Lowestoft Formation sands and gravels groundwater (Secondary A Aquifer).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Lowering of groundwater levels.		Minor adverse.		Minor adverse **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Lowestoft Formation (diamicton) groundwater (Secondary Aquifer (un-differentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Lowering of groundwater levels.		Negligible		Negligible **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial **(not significant)**.
Groundwater abstractions identified within 500m of the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.
	Contamination mobilised during		Minor adverse.		Minor beneficial **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	operation migrating to the abstraction.				
Groundwater abstraction between 500m and 1km of the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect **(not significant)**.
	Contamination mobilised during construction migrating to the abstraction.		No effect.		No effect **(not significant)**.
Potential PWS.	Reduction in groundwater availability to the PWS.		Minor adverse/no effect.		Minor/no effect **(not significant)**.
	Contamination mobilised during construction migrating to the PWS.		Minor adverse.		Minor beneficial **(not significant)**.
Leiston drain (Main River).	Contamination of the river.	Control measures adopted during the de commissioning phase of the site would be as described for the construction phase. Implementation of appropriate pollution incident control. Spill kits would be available on site at all times. Sand bags or stop logs would also be available for deployment on the outlets from the site	Minor adverse.	Remediation of soil and surface water receptor if necessary. Management and maintenance of the SuDS.	Minor adverse **(not significant)**.
Hundred River (Main River).	Contamination of the river.		Minor adverse.		Minor adverse **(not significant)**.
Existing drainage network within the site.	Contamination of the controlled waters.		Minor adverse.		Minor adverse **(not significant)**.
Ponds within the inner study area.	Contamination of the ponds.		Minor adverse.		Minor adverse **(not significant)**.
Surface water abstraction.	Contamination of the source.		Minor adverse.		Minor adverse **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
		drainage system in case of emergency spillages.			
Flood risk to surrounding areas	Loss of functional floodplain storage or displacement of sea or river water.	Swales will be incorporated into the design.	No effect.	Not required.	No effect **(not significant)**.

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