The Sizewell C Project

6.8 Volume 7 Yoxford Roundabout and Other Highway Improvements

Chapter 12 Groundwater and Surface Water

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12. Groundwater and Surface Water

12.1 Introduction

12.1.1 This chapter of **Volume 7** of the **Environmental Statement (ES)** presents an assessment of the groundwater and surface effects arising from the construction and operation of the proposed Yoxford roundabout and other highway improvements (referred to throughout this volume as the 'proposed development'). This includes an assessment of potential impacts, the significance of effects, the requirements for mitigation and the residual effects.

12.1.2 The proposed improvement works are as follows:

- a roundabout at the junction between the A12 and B1122 in Yoxford (referred to throughout as 'Yoxford roundabout');
- improvements at the A1094 and B1069 junction south of Knodishall;
- improvements at the A12 and A144 junction south of Bramfield; and
- improvements at the A12 and B1119 junction at Saxmundham.

12.1.3 Road safety analysis has also identified potential highway safety issues at two sites (the B1078 and B1079 junction east of Easton and Otley College and the A140 and B1078 junction west of Coddenham). Highway safety measures at these sites will be secured by an obligation in the Section 106 Agreement (see the **Section 106 Heads of Terms** appended to the **Planning Statement** (Doc. Ref. 8.4). This chapter includes an assessment of these highway safety measures.

12.1.4 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, safety measures and different construction and operation 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 **Appendix 1A** of **Volume 1** of the **ES** (Doc Ref. 6.2).

12.1.5 The Government's Good Practice Guide for Environmental Impact Assessment (EIA)[1] (Ref.12.1) outlines the potential environmental effects that should be considered for groundwater and surface water, for example physical effects of the development and effects on groundwater. Further information on these topics and which have been scoped into the assessment can be found in **section 12.3** of this chapter**.**

12.1.6 This assessment has been informed by data from other assessments as follows:

- **Appendix 11A** of this volume: Yoxford roundabout: Phase 1 Desk Study Report 2020;
- **Appendix 11B** of this volume: conceptual site models;
- **Appendix 11C** of this volume: impact assessment tables;
- **Yoxford Roundabout and Other Highway Improvements Flood Risk Assessment (FRA)** (Doc Ref. 5.7)); and
- **Water Framework Directive (WFD) Compliance Assessment Report** (Doc Ref. 8.14).

12.2 Legislation, policy and guidance

12.2.1 **Appendix 6O** of **Volume 1** of the **ES** 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:

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

- Water Framework Directive 2000/60/EC (Ref.12.2).
- Groundwater Daughter Directive 2006/118/EC (Ref.12.3).
- 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).
- 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).
- 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).
- 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.
- 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 (CIRIA) (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).
- 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 **Volume 1**, **Chapter 6** 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 screening exercise, as detailed below, and methodology applied to the assessment of the proposed development.

12.3.4 The scope of assessment considers the impacts of the construction and operation of the proposed development and safety measures. Where the highway improvement works or safety measures proposed have the potential for likely significant effects, these have been assessed in further detail.

12.3.5 The scope of this assessment has been established through a formal EIA scoping process undertaken with the Planning Inspectorate (PINS). A request for an EIA Scoping Opinion was initially issued to the PINS in 2014, with an updated request issued in 2019, see **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 the 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 WFD 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. Further assessment of identified effects from contamination to groundwater and surface waters 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 An environmental screening exercise has been undertaken to identify which of the four highway improvement works and two highway safety measures proposed may give rise to environmental effects that could potentially be significant. The outcome of this environmental screening exercise concluded that only the proposed Yoxford roundabout should be taken forward to the assessment of likely effects of potential impacts on groundwater and surface water.

12.3.12 The remaining three highway improvement works and two highway safety measures have been screened out of the groundwater and surface water assessment as they are not likely to give rise to significant environmental effects.

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

Table 12.1: Summary of environmental screening exercise

Proposed Highways Improvement / safety measures	Summary of Potential Effects	Screened in or out of the Assessment
The A12/B1122 Yoxford roundabout.	There is the potential for the proposed works to impact to groundwater and surface water receptors within, and adjacent to the site during the construction and operational phases. This is due to the proximity of controlled water receptors such as the River Yox and Waveney and East Suffolk Chalk and Crag groundwater body and because the works will include development on greenfield land. This therefore has the potential to result in significant effects to groundwater and surface water.	Screened in.
Improvements at the A1094/B1069 junction south of Knodishall.	All construction works would be undertaken within the highway's boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. All works would be completed in	Screened out.

Proposed Highways Improvement / safety measures	Summary of Potential Effects	Screened in or out of the Assessment
	accordance with current best practice and mitigation measures as set out in the **CoCP** to reduce any adverse effects.	
Improvements at the A12/A144 junction south of Bramfield.	The minor junction improvement works would involve a provision of a central reservation island and waiting area. Although there will be minor land requirements from outside the highway boundary, the majority of the works will be within the highway boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. All works would be completed in accordance with current best practice and mitigation measures as set out in the **CoCP** to reduce any adverse effects.	Screened out.
Improvements at the A12/B1119 junction at Saxmundham.	The minor junction improvement works would involve slight widening of the B1119 at the junction. Construction works can be undertaken within the highway's boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted. All works would be completed in accordance with current best practice and mitigation measures as set out in the **CoCP** to reduce any adverse effects.	Screened out.
Safety measures at the B1078/B1079 junction east of Easton and Otley College.	All construction works would be undertaken within the highway's boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted.	Screened out.
Safety measures at the A140/B1078 junction west of Coddenham.	All construction works would be undertaken within the highway's boundary and would not create a mechanism by which groundwater and surface water receptors would be impacted.	Screened out.

d) Study area

12.3.14 The study area for the consideration of effects from contaminative sources on controlled waters for the proposed Yoxford roundabout 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

12.3.15 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.

12.3.16 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.

12.3.17 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.

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

e) Assessment scenarios

12.3.19 The assessment of effects on the water environment includes the assessment of both the construction phase and operational phase of the proposed development, rather than the assessment of any specific years.

f) Assessment criteria

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

i. Assessment of physical impacts

12.3.21 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.

12.3.22 The assessment criteria of physical impacts on groundwater and surface water receptors and resources are based on the methodology provided in **Appendix 6O** of **Volume 1** of the **ES** and summarised below.

Sensitivity

12.3.23 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 has some resilience to disturbance or change. An attribute with high quality/rarity, at a regional scale that has 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

12.3.24 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 (i.e. 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.

12.3.25 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.

12.3.26 Given the timescales of the Sizewell C Project, the nature of potential changes to the water environment from the proposed Yoxford roundabout 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 definitions

12.3.27 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

12.3.28 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.

12.3.29 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

12.3.30 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.

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

iii. Water Framework Directive compliance

12.3.32 WFD 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 WFD.

12.3.33 The significance of effects on WFD 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.

12.3.34 The **WFD Compliance Assessment** (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

12.3.35 The **Yoxford Roundabout and Other Highway Improvements FRA** (Doc Ref. 5.7) has been provided as a separate document submitted alongside this application for development consent. The main conclusions from the FRA 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

12.3.36 **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

12.3.37 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 resources and receptors from the construction and operational 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.

12.3.38 The assessment also considers the findings of the **WFD Compliance Assessment** and the **Yoxford Roundabout and Other Highway Improvements FRA.**

ii. Existing baseline

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

12.3.40 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); and

- **Appendix 11A** of this volume: Yoxford Roundabout: 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

12.3.41 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 WFD water bodies).

iv. Assessment

12.3.42 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

12.3.43 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 2.5** of **Chapter 2** of this volume of the **ES** and as illustrated on the **Work Plans** (Doc Ref. 2.3) reproduced in **Appendix 2B** of this volume.

- Excavation works carried out as part of the proposed development will be shallow, including a cutting within the limits of deviation.

- Surface water discharge will be managed so it does not exceed the predetermined Greenfield run-off rates in accordance with the **Outline Drainage Strategy** in **Appendix 2A** of **Volume 2** of the **ES**.

- 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.

12.3.44 The following limitations have been identified:

- Ground investigation has not been carried out at the site at the time of writing but will be undertaken prior to the commencement of construction. Therefore, no observed information about the ground conditions at the site or encountered groundwater was available for the production of this assessment. Publicly available information from the BGS such as historical borehole logs has been used to inform the assessment.

- 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 Yoxford Roundabout

a) Baseline environment

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

12.4.2 Further detail can be found in **Appendix 11A** (the Phase 1 Desk Study Report) of this volume.

i. Current baseline

Site Walkover

12.4.3 A site walkover 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. Additionally, it was an opportunity to identify potential visual or olfactory contamination present at the site at the time of the walkover.

12.4.4 The site was noted to comprise the existing A12 and B1122 roads and an area of agricultural land. No hazards or evidence of contamination were observed during the site walkover. Further details on observations made during the site walkover including photographs can be found in the Phase1 Desk Study Report, **Appendix 11A** of this volume.

Topography

12.4.5 The proposed Yoxford roundabout site is located in the River Yox catchment. Light detection and ranging data show that the highest ground levels are located in the south of the site, at approximately 16m Above Ordnance Datum (AOD). Ground levels drop to the west and east of the site, with the lowest ground levels at approximately 10m AOD at the south-west edge.

Geology

12.4.6 Made Ground is not shown on the BGS online mapping, however the areas adjacent to the existing roads have the potential to include Made Ground. Due to the nature of the site there is the potential for fly tipping as well as the potential for farmers' tips, the constituents of which will be unknown.

12.4.7 Online BGS mapping indicates that the majority of the site is not underlain by superficial deposits. Part of the northern section of the site is underlain by the Head Formation which is made up of clay, silt, sand and gravel.

12.4.8 Off-site, alluvial deposits associated with the River Yox are present to the north, with diamicton deposits and sands and gravels deposits of the Lowestoft Formation also present within the study area.

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

12.4.10 BGS borehole scan reference TM46NW27 located at national grid reference (NGR) 640130 268680 (10m from the site) suggests that the Crag aquifer is likely to extend at least 31m below ground level (bgl). BGS scans of shallow boreholes adjacent to the northern extent of the site indicate made ground is present to 0.5 – 1m bgl. This is underlain by varying thicknesses and sequences of clay, sand and silt. Bedrock was not encountered in any of these nearby boreholes.

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 superficial Head Deposits in the north of the site as Secondary Aquifer (undifferentiated)[2].

12.4.13 The Environment Agency classifies the Crag Group bedrock underlying the site as a Principal Aquifer[3].

12.4.14 The site does not lie within 1km of a groundwater Source Protection Zone (SPZ)[4].

12.4.15 Current groundwater levels at the site are not yet established. However, contours shown on BGS hydrogeological mapping (Ref. 12.33) suggest that Crag groundwater levels at the site are around 7m AOD (approximately 10m bgl). These contours are based on data from 1976 and are only indicative of current levels, however the hydrogeological regime is considered unlikely to have changed substantially in the intervening years. Further ground investigation would be needed to confirm current groundwater levels at the site.

12.4.16 BGS borehole scan reference TM46NW27 is located approximately 10m north-east of the site and records a rest water level of 4.4m bgl within the Crag deposits. The datum for the borehole is not provided in the log, therefore it is not possible to convert the groundwater level to m AOD.

12.4.17 The site is located on the Waveney and East Suffolk Chalk and Crag groundwater body (groundwater body ID GB40501G400600). This groundwater body has been classified by the Environment Agency 2016 classification as being of poor quantitative and poor chemical status (2016), 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.

12.4.18 The site falls within a groundwater nitrate vulnerable zone.

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2 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.

3 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.

4 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.

Surface water features

12.4.19 The River Yox is located directly to the north of the site and is designated as a Main River. The Environment Agency's Catchment Data Explorer (Ref.12.34) defines the reach in the vicinity of the site as a component of the Minsmere Old River water body (water body ID GB105035046270) as presented in **Figure 12.1** of this volume. The catchment of the Minsmere Old River water body is drained by four principal rivers, namely the River Yox, Minsmere River, Minsmere New Cut River and the Minsmere Old River. According to the Environment Agency 2016 classification the Minsmere Old River water body has an overall classification of Moderate ecological potential and for the purpose of this assessment, these standards have been applied to the River Yox.

12.4.20 An unnamed tributary of the River Yox is located 10m to the east of the site. There is a pond approximately 10m to the north-east of the red line boundary of the site. Additionally, a sewage treatment works is located to the north-east of the site, approximately 100m from the site boundary.

Water quality

12.4.21 The 2016 physico-chemical and chemical data presented on Catchment Data Explorer for the Minsmere Old River water body have been reviewed to characterise the Minsmere Old River catchment, including the River Yox.

12.4.22 Physico-chemical data indicate that the Minsmere Old River water body is at good or high status for ammonia, biochemical oxygen demand, dissolved oxygen, pH, phosphate and temperature, and are not adversely affected by pollutants such as copper, triclosan and zinc. The water body is at good physico-chemical status. This suggests that water quality in the catchment is generally good and these standards have been taken as representative of the River Yox in the vicinity of the site.

12.4.23 No groundwater quality data is available for the site.

Groundwater and surface water interaction

12.4.24 Given the local geology and depth to groundwater, there is considered to be a potential hydraulic connection between groundwater and surrounding surface water features within the study area where superficial deposits of the Lowestoft Formation (diamicton) are absent. It is therefore considered that there is a potential hydraulic connectivity between the River Yox and its tributaries and the underlying alluvial and Crag aquifers.

Water abstractions

Groundwater

12.4.25 Two licensed groundwater abstractions have been identified within the outer study area. These are detailed in **Table 12.5** and presented on **Figure 12.1** of this volume.

Table 12.5: Licensed groundwater abstractions within the outer study area

Licence Number.	Location (including NGR).	Source	Purpose	Maximum Annual Abstraction (m^3).
7/35/03/*G/0032	639700, 268770 (100m west of site). Borehole at Limes, Yoxford.	Groundwater (Crag).	General farming and domestic: All year round	Unknown.
7/35/03/*G/0035	640100, 268310 (298m south of site). Borehole at Rookery Park, Yoxford.	Groundwater (Crag).	General farming and domestic: All year round	Unknown.

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

Surface water

12.4.27 One licensed surface water abstraction has been identified within the outer study area. This is detailed in **Table 12.6** and presented on **Figure 12.1** of this volume**.**

Table 12.6: Licensed surface water abstractions within the outer study area

Licence Number.	Location (including NGR).	Source	Purpose	Maximum Annual Abstraction (m^3).
7/35/03/*S/0050	640340, 268760 (240m east of the site). Minsmere River at Trustans Farm, Darsham.	Surface water (River Yox)	General Agriculture: Spray irrigation-Direct. Seasonal-abstraction only 01 May	Unknown

Licence Number.	Location (including NGR).	Source	Purpose	Maximum Annual Abstraction (m^3).
			to 30 Sept.	

Fluvial geomorphology

12.4.28 The surface watercourses in the area are typical of lowland, low energy drainage systems. Many of the channels are entirely artificial, and the natural channels have been extensively modified (probably to facilitate drainage and use of the surrounding marshland as grazing marsh). The River Yox and the unnamed tributary have been straightened and appear to have been modified for land drainage and land management purposes.

12.4.29 Sediment deposition and, when flows have sufficient energy, transport are likely to be the dominant fluvial processes which operate in the Minsmere Old River. The behaviour of the fluvial system is largely dominated by artificial modifications, principally the operation of the Minsmere sluice, which prevents free drainage during high tide or increased water levels.

12.4.30 Geomorphology and hydromorphology are key factors contributing to whether a water body can achieve or maintain good ecological status. The Minsmere Old River water body is designated as a heavily modified water body. This designation appears representative of the watercourse in the vicinity of the site. The hydrological regime is of sufficient quality to support good status.

Flood risk

12.4.31 The East Suffolk Council Strategic FRA identified one historic case of foul or surface water flooding as having occurred approximately 150m to the west of the proposed Yoxford roundabout site.

12.4.32 The majority of the site is located in Flood Zone 1, and therefore has a low risk of flooding from tidal or fluvial sources. The northern extent of the site is in Flood Zone 2 by the A12 bridge over the River Yox as presented on **Figure 12.1** of this volume. The Flood Zone 2 extent has an approximate level of 9.5m AOD immediately to the east of the road. The A12 is approximately 1m above the Flood Zone 2 extent. Risks associated with groundwater, sewer and reservoir flooding at the site are also considered to be low.

12.4.33 The Environment Agency's long-term flood risk mapping shows that the majority of the site is also at very low risk of flooding from surface water. However, there are two areas of surface water flood risk identified; one

area of low risk of surface water flooding is located on the B1122 at the eastern extent of the site, and the other area at high risk of surface water flooding is located on the A12 at the western extent of the site.

12.4.34 Further information on flood risk at the site is provided in the **Yoxford Roundabout and Other Highway Improvements FRA** (Doc Ref. 5.7), which has been submitted as part of this application for development consent.

Historic and environmentally sensitive sites

12.4.35 Further consideration of historic and ecological designated sites, both statutory and non-statutory is given in **Chapters 7** and **9** of this volume. A review of the MAGIC website has confirmed that there are no statutory designated water dependent ecological sites within the outer study area. A non-statutory designated ecological site is located adjacent to the site and is designated for a specific fungi species, the assessment of which is contained within **Chapter 7**.

12.4.36 The lower portion of the Minsmere Old River system has been designated for its nature conservation value. The southern parts of the surface drainage network comprise the nationally and internationally designated Minsmere to Walberswick Heaths and Marshes Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protected Area (SPA) and Ramsar site. Whilst not within the outer study area, the potential effects on these sites have been considered within **Chapter 7** in any case due to the potential for connectivity with the River Yox adjacent to the site.

Existing buildings

12.4.37 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 Yoxford to the west. The closest building to the site is Rookery Lodge, approximately 5m south of the site boundary.

Potential for existing contamination

12.4.38 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; and
- potential for unexploded ordnance.

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

Summary of key receptors

12.4.40 The key receptors for potential effects are summarised in **Table 12.7.**

Table 12.7: Key receptors within the proposed Yoxford roundabout site area

Receptor	Receptor Sensitivity to Physical Effects.	Receptor Sensitivity to Contaminative Effects.
Crag groundwater (Principal Aquifer).	Medium	Medium
Head deposits (Secondary Aquifer (undifferentiated)).	Very low	Medium
Groundwater abstractions.	Medium	Medium
Potential PWS.	Medium	Medium
Existing buildings.	Medium	Low
Surface Water abstraction	Medium	Low
River Yox (Main River)	Medium	Low
Existing ponds within study area.	Very Low	Low

Future baseline

12.4.41 Committed developments have been considered as future receptors in the assessment of ground and surface water impacts during the construction and operation phases of the proposed Yoxford roundabout. The two committed developments which have been identified within the inner study area are summarised in **Table 12.8.**

Table 12.8: Committed developments

Planning Application Ref.	Site Address	Description of Development	Date of Approval	Status	Distance (m)
DC/16/2077/OUT	Cavan Cottage High Street Yoxford	New additional detached 3 Bed dwelling within the	07/12/2016	Construction not commenced	79

Planning Application Ref.	Site Address	Description of Development	Date of Approval	Status	Distance (m)
	Saxmundham Suffolk IP17 3EU	curtilage of Cavan Cottage			
DC/18/1394/FUL	Beaubelle, Part Side Garden Westleton Road Yoxford IP17 3LD	Construction of 2no. new two storey private residential dwellings with upgraded vehicular access, parking & turning area.	26/08/2016	Construction not commenced	276

12.4.42 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.

12.4.43 Climate change will be taken into account in the detailed drainage design through the application of the appropriate rainfall intensity allowances.

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

12.4.45 As the length of the construction and operational phases of the Yoxford roundabout will cover a 10+ year period, changes to the WFD status of the Minsmere Old River water body could be realised, relating to the default 'good status' been achieved by 2027 and beyond. Although WFD status is only relevant to the **WFD Compliance Assessment** (Doc Ref. 8.14). By-products, such as improved water quality, geomorphology or biology as a result of WFD implementation should be considered within the evolution of the future baseline.

12.4.46 The future baseline of the Minsmere Old River WFD water body is not predicted to change and it is assumed that this will equally apply to the River Yox in the vicinity of the site. This judgement is based on the following factors:

- physico-chemical quality is already meeting required standards (good or high), so will not be improved through the implementation of the Anglian RBMP;

- the hydrological regime for the Minsmere Old River already supports good, so will not be improved through the implementation of the Anglian RBMP;
- the heavily modified water body designation recognises that morphological changes are fixed and there is no prospect for change through the implementation of the Anglian RBMP;
- biological quality elements will remain poor due to the unfavourable balance of costs and benefits to improve the status of fish within the system. This is due to physical modifications such as hard barriers and land drainage for agriculture and rural land management; and
- Poor biological status is not anticipated to improve so the ecological status will remain as moderate throughout the construction and operational phases of the Yoxford roundabout.

b) Environmental design and mitigation

12.4.47 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 Yoxford roundabout and other highway improvements. Tertiary mitigation measures are legal requirements or are standard practices that would be implemented as part of the proposed Yoxford roundabout.

12.4.48 The assessment of likely significant effects of the proposed Yoxford roundabout assumes that primary and tertiary mitigation measures are in place. For groundwater and surface water, these measures are identified below, with a summary provided on how the measures contribute to the mitigation and management of potentially significant environmental effects.

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

i. Primary mitigation

12.4.50 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 Yoxford roundabout.

Construction phase

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

Operational phase

12.4.52 The proposed drainage system would incorporate sustainable urban drainage systems (SuDS) measures as set out in the **Outline Drainage Strategy** in **Appendix 2A** of **Volume 2** of the **ES**. This would consist of channels, kerb drains or gullies that would remove surface water run-off. Underground drains would convey the run-off to an infiltration basin located between the proposed roundabout and the proposed access road to the south. The infiltration basin would hold the run-off and discharge run-off through infiltration to ground.

12.4.53 Petrol/oil interceptors and silt traps would be incorporated into the drainage design, where considered necessary, to protect both the underlying groundwater and surface water receptors, and to maintain the efficacy of the drainage measures.

ii. Tertiary mitigation

12.4.54 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.

12.4.55 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.

12.4.56 Tertiary mitigation measures to be incorporated into the proposed Yoxford roundabout during enabling works, construction and operation, as set out in the **CoCP** (Doc Ref. 8.11) include:

- Construction drainage to be contained within the site to infiltrate into the underlying strata and, where appropriate, the existing drainage system to be used (i.e. at the junction with the existing A12 and the B1122). 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.

- Temporary SuDS to be implemented early in the construction phase. Construction phase water management zones to intercept surface run-off, sediment and contaminants from the construction compound and laydown areas, and incorporate sustainable drainage measures

such as swales, filter drains, infiltration ponds and soakaways to promote infiltration.

- 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 from the construction compound 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 a contamination watching brief by suitably qualified and experienced personnel would be completed when excavating areas of potential contamination risk.

- Implementation of appropriate pollution incident control e.g. 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, should contaminative substances be identified suitable measures (e.g. wheel washing) should be implemented.

- Concrete and cement mixing and washing areas would be situated at least 10m away from 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.

12.4.57 Additional tertiary mitigation that would be anticipated and referenced in the **CoCP** 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**.

c) Assessment

i. Introduction

12.4.58 This section presents the findings of the groundwater and surface water assessment for the construction and operation of the proposed Yoxford roundabout.

12.4.59 This section identifies any likely significant effects that are predicted to occur and **section 12.4** of this chapter then highlights any secondary mitigation and monitoring measures that are proposed to minimise any adverse significant effects if required.

ii. Construction

Groundwater level and flow regime

12.4.60 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 infiltrating to ground is unlikely to change substantially. The impact to groundwater from this activity would be very low, resulting in negligible effect for the very low value superficial aquifer and minor adverse effect for the medium value Crag aquifer. The effect would be **not significant**.

12.4.61 Current groundwater levels at the site have not been established, however, data available from the BGS for a borehole close to the site (TM46NW27, approximately 10m east), records that groundwater level in the Crag aquifer was approximately 4.4m bgl. The cutting for the construction of the realignment of the B1122 has a design depth of 2m bgl, however this may vary by up to 1m as set out in **section 2.5** in **Chapter 2** of this volume. It is therefore anticipated that groundwater in the underlying Crag aquifer would not be encountered during construction. It is therefore anticipated that

groundwater dewatering during construction is not likely to be required and that there would be **no effect** on the underlying aquifers with respect to dewatering activities.

12.4.62 The River Yox is located directly north of the site and is considered to have the potential to receive baseflow from the underlying aquifers. With the implementation of the primary and tertiary mitigation measures identified, the river is unlikely to be affected by the localised changes to the hydrogeological environment identified. It is concluded that there would be **no effect** on the river with respect to groundwater level and flow.

12.4.63 The groundwater abstractions identified are located at 100m west and 298m south from the site and are understood to abstract from the Crag Aquifer. Due to their distance from the site and with the implementation of the primary and tertiary mitigation measures identified, they are unlikely to be affected by any local changes to the hydrogeological environment. It is concluded that there would be **no effect** on the abstractions with respect to water level and flow.

12.4.64 There are no known PWS in the outer study area, however due to there being no anticipated requirement for dewatering at the site during construction it is concluded that there would be **no effect** on PWS in the outer study area with respect to groundwater level and flow.

12.4.65 It is concluded that there would be no effect on the medium value existing buildings in terms of groundwater level and flow. This is because there is no anticipated requirement for dewatering at the site during construction.

Contamination of groundwater

12.4.66 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.

12.4.67 Earthworks activities such as excavation of cuttings during the construction process create a potential pathway for existing on-site contamination to reach groundwater. Based on the information in the BGS borehole logs in the area, it is likely that the cutting will extend into the Crag deposits, however it is unlikely to intercept the water table.

12.4.68 As presented in **Chapter 11** of this volume, there is the potential for existing contamination at the site, as well as the introduction of new contaminants and preferential pathways through construction activities. However, 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.

12.4.69 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 superficial deposits are absent, there is a potential pathway for contamination to reach the Crag groundwater.

12.4.70 Where 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 the spill or leak is likely to be small and is likely to be captured before loss to ground.

12.4.71 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**.

12.4.72 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**.

12.4.73 The River Yox is considered to have the potential to receive baseflow from the underlying aquifers and therefore there is a potential pathway for groundwater contamination to reach the watercourse. The assessment of the impact to the River Yox with respect to quality is presented below at 'contamination of surface waters'.

12.4.74 The groundwater abstraction boreholes at Limes and Rookery Park both abstract from the Crag aquifer and are located 100m and 298m from the site boundary respectively. Due to their proximity to the site and the minimal presence of superficial deposits at the site, it is considered that there is the potential for contamination from the site activities to migrate to the abstractions, through leaching through the soil or via the creation of preferential pathways. With the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstractions is the same as for the aquifer from which they abstract groundwater. This is an increase from the existing baseline during the construction activities and the effect is classified as minor adverse. The effect would be **not significant**.

12.4.75 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**.

12.4.76 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 in **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.

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

Alteration of the surface water flow regime

12.4.78 Any changes to the flow regime have the potential to increase existing pressures and adversely affect the hydromorphology of the River Yox. Changes to the flow regime also have the potential to adversely affect the surface water abstraction (Trustans Farm, Darsham) from the River Yox. The sensitivity of these receptors is considered medium.

12.4.79 Where construction increases the extent of bare and compacted ground for a prolonged period, there is the potential for an increase in surface run-off and increase in flood peaks in the nearest receptor. The proposed Yoxford roundabout would create new areas of bare ground for prolonged periods during the construction phase.

12.4.80 Construction phase water management is embedded in the design, with on-site surface water run-off being infiltrated or discharged at greenfield run-off rates until the SuDS infrastructure is operational. This will result in a very low magnitude effect. This effect is classified as negligible and considered to be **not significant** for the River Yox and the surface water abstraction. Once the drainage infrastructure is operational, there will be no effect.

Contamination of surface waters

12.4.81 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 River Yox, the existing pond to the north-east of the A12 and B1122 site and the surface water abstraction (Trustans Farm, Darsham) from the River Yox increasing existing pressures on these receptors.

12.4.82 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 construction of the proposed Yoxford roundabout would involve excavations and therefore has the potential to introduce contaminants during the construction phase.

12.4.83 The site would be isolated from the wider environment until the SuDS is operational. 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 surface drainage network.

12.4.84 As detailed in **Appendices 11B** and **11C** of this volume, the risk on the River Yox and the existing pond from both lateral migration of existing contamination and discharge of contaminants from construction activities is considered to remain the same as the baseline risk. The effects from both impacts on these surface water receptors are classified as negligible and considered to be **not significant**.

12.4.85 Contamination of surface waters arising from construction activities also have the potential to affect the existing surface water abstraction (Trustans Farm, Darsham) from the River Yox. Based on the protection afforded by the primary and tertiary mitigation, a negligible effect is predicted for the surface water abstraction, which is considered to be **not significant**.

12.4.86 It is considered that there is no 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 in **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.

Flood risk

12.4.87 The proposed Yoxford roundabout would include sustainable drainage to manage any additional surface water run-off from it. A combination of infiltration and controlled discharge methods are proposed for the discharge of surface water runoff, to be agreed with the Highway Authority. 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.

12.4.88 Further information on flood risk at the site is provided in the **Yoxford Roundabout and Other Highway Improvements FRA** (Doc Ref. 5.7) which has been submitted as part of this application for development consent.

WFD compliance

12.4.89 The site is located within the Minsmere Old River WFD water body catchment and on the Waveney and East Suffolk Chalk and Crag groundwater body. The WFD Compliance assessment demonstrates that proposed construction activities would not have direct or indirect effects on the Minsmere Old River and Waveney & 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.

12.4.90 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.

12.4.91 Further information on WFD compliance is provided in the **WFD Compliance Assessment** (Doc Ref. 8.14) which has been submitted as part of this application for development consent.

Inter-relationship effects

12.4.92 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 Yoxford roundabout.

12.4.93 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 Yoxford roundabout.

12.4.94 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.

12.4.95 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment (**Chapter 11** of this volume) and no further combined effects are anticipated.

12.4.96 The assessment of terrestrial ecology and potential inter-relationship effects with ground and surface water effects is considered in **Chapter 7** of this volume.

iii. Operation

Groundwater level and flow regime

12.4.97 The cutting for the realignment of the B1122 is unlikely to intercept the water table and therefore no groundwater dewatering control measures are anticipated to be required during the operation of the proposed Yoxford roundabout. Therefore, there is no potential impact to groundwater levels, and to existing buildings, from the proposed Yoxford roundabout with respect to dewatering.

12.4.98 The proposed drainage design incorporates the use of SuDS. Water falling onto impermeable surfaces would be channelled into the SuDS infrastructure. This would allow infiltration to ground and would mean that although the spatial distribution of infiltration would be changed locally within the development area, the total volume of infiltration entering the ground would not be significantly changed relative to the groundwater system. The impact to the very low value superficial aquifer would therefore be of very low magnitude and the effect classified as negligible. The impact to the medium value Crag Aquifer would be minor adverse. Both effects would be **not significant**.

12.4.99 The groundwater abstractions identified are located at 100m west and 298m south from the site and are understood to abstract from the Crag Aquifer. Due to their distance from the site and with the implementation of

the primary and tertiary mitigation measures identified, they are unlikely to be affected by any local changes to the hydrogeological environment. It is concluded that there would be **no effect** on the abstractions with respect to water level and flow.

12.4.100 Whilst there are no known PWS in the outer study area, the superficial and bedrock aquifers are anticipated to experience no discernible change resulting from the proposed Yoxford roundabout. 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**.

Contamination of groundwater

12.4.101 As presented in **Chapter 11** of this volume and its appendices, the operation of the proposed Yoxford roundabout could introduce new sources of contamination to the site through chemical spills and leaks 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** and in **Chapter 11** of this volume, would reduce this risk.

12.4.102 During operation the main risks from contamination come from vehicles using the roundabout and adjoining roads. The proposed configuration of the Yoxford roundabout represents a marked improvement on the existing junction and its drainage arrangements. It is not anticipated that significant spills or leaks will occur from vehicles used for commuting purposes. It is understood that contamination from these sources would be of limited magnitude and longevity and would be mitigated through tertiary mitigation methods. The presence of silt traps and hydrocarbon interceptors within the drainage design would prevent the supply of sediment and other contamination to the drainage network. The provision of the infiltration basin would protect the underlying groundwater from hydrocarbon contamination.

12.4.103 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**.

12.4.104 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**.

12.4.105 The groundwater abstraction boreholes at Limes and Rookery Park both abstract from the Crag aquifer and are located 100m and 298m from the site boundary respectively. Due to their proximity to the site and the minimal presence of superficial deposits at the site, it is considered that there is the potential for contamination from the site activities to migrate to the abstractions, through leaching through the soil or via the creation of preferential pathways. With the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstractions is the same as for the aquifer from which they abstract groundwater. This is a decrease from the existing baseline during the operational activities and the effect is classified as minor beneficial. The effect would be **not significant**.

12.4.106 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, it is anticipated that the risk to the PWS is the same as for the aquifer from which they abstract groundwater. This is a decrease from the existing baseline during the operational activities and the effect is classified as minor beneficial. The effect would be **not significant**.

12.4.107 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 in **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.

Alteration of the surface water flow regime

12.4.108 Any changes to the flow regime during operation have the potential to increase existing pressures and adversely affect the hydromorphology of the River Yox. Changes to the flow regime also have the potential to adversely affect the surface water abstraction (Trustans Farm, Darsham) from the River Yox. The sensitivity of the receptor is considered medium.

12.4.109 An increase in the extent of hardened surfaces has the potential lower the infiltration rate and could increase surface run-off in receiving watercourses. Whilst the proposed Yoxford roundabout will have areas of impermeable surfaces, an operational drainage system is embedded in the design, with on-site surface water run-off being infiltrated or discharged at greenfield run-off rates. **No effect** is predicted for the River Yox and surface water abstraction.

Contamination of surface waters

12.4.110 A significant number of heavy goods and commuter vehicles will utilise this junction, particularly during the peak construction of the main development site. In developing the design for the remodelled junction, the proposed configuration was selected for this site on the basis of the current traffic flows, plus construction phase and operational requirements for the main site. The configuration represents a marked improvement on the existing junction and its drainage arrangements.

12.4.111 The operation phase drainage features would include channels and combined kerb drains or gullies to remove surface water run-off. Underground drains would convey the run-off into an infiltration basin located between the proposed Yoxford roundabout and the existing B1122 carriageway, from where the water would infiltrate to ground. There would be no discharge to local watercourses.

12.4.112 Based on this proposed drainage system, the risk of contaminants reaching a surface water receptor is lower for the new junction arrangement than for the existing road layout and associated drainage arrangements. However, chemical spills and leaks still have the potential to occur during the operational phase and thus have the opportunity to adversely affect the water quality of the River Yox, the existing pond and the surface water abstraction (Trustans Farm, Darsham) from the River Yox.

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

12.4.114 On the basis of the implementation of the primary and tertiary mitigation measures, a negligible effect is predicted for the surface water abstraction, which is considered to be **not significant**.

12.4.115 It is considered that there is no 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 in **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.

Flood risk

12.4.116 The majority of 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 Yoxford roundabout. The proposed Yoxford roundabout will not, therefore, increase flood risk to surrounding areas.

12.4.117 The site is currently a mixture of existing highways infrastructure and greenfield. The proposed Yoxford roundabout would increase the impermeable area of the road which would increase the associated surface water runoff from the site. However, the proposed **Outline Drainage Strategy** in **Appendix 2A** of **Volume 2** of the **ES** (Doc Ref. 6.3) would reduce surface water flood risk from run-off that currently flows along the existing A12 into Yoxford village. In the unlikely event that ground conditions prevent full use of infiltration to ground, the pond would become a combined infiltration and attenuation pond.

12.4.118 The proposed Yoxford roundabout is classed as being 'Essential Infrastructure' under the NPPF and is located primarily in Flood Zone 1, with a small part in Flood Zone 2. The development is considered appropriate in flood Zones 1 or 2 in terms of flood risk vulnerability and therefore passes the sequential test. Based on the proposed mitigation measures and in accordance with the NPPF guidance, the development is considered to be appropriate in terms of flood risk and therefore no effect is predicted.

12.4.119 Further information on flood risk at the site is provided in the **Yoxford Roundabout and Other Highway Improvements FRA** (Doc Ref. 5.7) which has been submitted as part of this application for development consent.

WFD compliance

12.4.120 The site is located within the Minsmere Old River WFD water body catchment and on the Waveney and East Suffolk Chalk and Crag groundwater body. The WFD assessment demonstrates that proposed operational activities would not have direct or indirect effects on the Minsmere Old River and Waveney & 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.

12.4.121 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.

12.4.122 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 WFD.

12.4.123 Further information on WFD compliance is provided in the **WFD Compliance Assessment** (Doc Ref. 8.14) which has been submitted as part of this application for development consent.

Inter-relationship effects

12.4.124 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 Yoxford roundabout.

12.4.125 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 Yoxford roundabout.

12.4.126 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment (**Chapter 11** of this volume) and no further combined effects are anticipated.

12.4.127 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.

12.4.128 The assessment of terrestrial ecology and potential inter-relationship effects with ground and surface water effects is considered in **Chapter 7** of this volume.

d) Mitigation and monitoring

12.4.129 Primary and tertiary mitigation measures which have already been incorporated within the design of the proposed Yoxford roundabout are detailed in **section 12.4** of this chapter. Where other mitigation is required, this is referred to as secondary mitigation, and where reasonably practicable, secondary mitigation measures have been proposed.

12.4.130 This section describes the proposed secondary mitigation measures for the groundwater and surface water as well as describes any monitoring required of specific receptors/resources or for the effectiveness of a mitigation measure.

i. Mitigation

12.4.131 A ground investigation would be undertaken to inform the detailed design of the proposed Yoxford roundabout and confirm ground conditions, contamination status and other ground related risks. This would be completed prior to the commencement of the construction works. Where the ground investigation identifies contamination and ground related risks, further detailed quantitative risk assessment will be undertaken and appropriate remediation measures in respect of soil and groundwater contamination prior to construction may be required.

12.4.132 Active management and maintenance of the drainage infrastructure would be required to ensure the continued efficacy of the surface water drainage system.

12.4.133 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.

ii. Monitoring

12.4.134 A programme of gas, groundwater, and surface water monitoring would be designed as part of the ground investigation which will take place prior to the detailed design and would be required prior to construction works commencing. Depending on the results of the monitoring, further long-term gas and groundwater monitoring may be required.

12.5 Other highway improvements

12.5.1 As identified in **section 12.3** of this chapter, the other highway improvements and safety measures are not considered to have the potential to result in significant environmental effects and therefore none require further assessment in this section.

12.6 Residual Effects

12.6.1 **Table 12.9** and **Table 12.10** 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 12.9: Summary of effects for the construction phase

Receptor	Impact	Primary or Tertiary Mitigation.	Assessment of Effects.	Additional Mitigation.	Residual Effects.
Crag groundwater (Principal Aquifer).	Reduction in the rate/volume of water discharging to ground.	Appropriate drainage design. Temporary SuDS and water management zones. Ensuring all site activities are carried out in accordance with the **CoCP** (Doc Ref. 8.11).	Minor adverse.	Ground investigation and relevant risk assessments completed prior to detailed design and construction works. Remediation of soil and groundwater if necessary. Longer term gas and groundwater monitoring if necessary.	Minor adverse **(not significant)**.
	Lowering of groundwater levels.		No effect.		No effect **(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)**.
Head Formation (Secondary Aquifer (undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Lowering of groundwater levels.		No effect.		No effect **(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 abstraction within 1km	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.
of the site boundary.	Contamination mobilised during consturction migrating to the abstraction.		Minor adverse.		Minor beneficial **(not significant)**.
Potential PWS.	Reduction in groundwater availability to the PWS.		No effect.		No effect **(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)**.
River Yox (Main River).	Alteration of flow regime.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground.	No effect.	Ground investigation and relevant risk assessments completed prior to detailed design and construction works. . Remediation of soil and surface water receptor if necessary. Longer term surface water monitoring if necessary.	No effect **(not significant)**.
	Contamination of the river.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground.	Negligible	Not required.	Negligible **(not significant)**.

Receptor	Impact	Primary or Tertiary Mitigation.	Assessment of Effects.	Additional Mitigation.	Residual Effects.
Existing pond.	Contamination of the controlled waters.	Ensuring all site activities are carried out in accordance with the **CoCP**	Negligible	Ground investigation and relevant risk assessments completed prior to detailed design and construction works. Remediation of soil and surface water receptor if necessary. Longer term surface water monitoring if necessary.	Negligible **(not significant)**.
Surface water abstraction.	Alteration of flow regime.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground.	No effect.		No effect **(not significant)**.
	Contamination of the river.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Ensuring all site activities are carried out in accordance with the **CoCP**.	Negligible		Negligible **(not significant)**.
Flood risk to surrounding areas	Loss of functional floodplain storage or displacement of sea or river water	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground.	No effect.	Not required.	No effect **(not significant)**.

Table 12.10: Summary of effects for the operational phase

Receptor	Impact	Primary or Tertiary Mitigation.	Assessment of Effects.	Additional Mitigation.	Residual Effects.
Crag groundwater (Principal Aquifer).	Reduction in the rate/volume of water discharging to ground.	Water draining from the car parking areas will pass through appropriate drainage, including the incorporation of SuDS and petrol/oil interceptors where necessary. This	Minor adverse.	Longer term gas, and groundwater monitoring if necessary. Management and maintenance	Minor adverse **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		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.	will allow infltration to the superficial aquifer, whilst also protecting the underlying groundwater from hydrocarbon contamination.	Minor beneficial.	of the SuDS.	Minor beneficial **(not significant)**.
Head Formation (Secondary Aquifer (undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible		Negligible **(not significant)**.
	Leaching/migration of contamination in soils to groundwater.		Minor benficial.		Minor beneficial **(not significant)**.
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial **(not significant)**.
Groundwater abstraction within 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.		Minor beneficial.		Minor beneficial. **(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 beneficial.		Minor beneficial. **(not significant)**.
River Yox (Main River).	Alteration of the flow regime.	Infiltration basin and existing drainage would intercept drainage from the proposed Yoxford roundabout.	No effect.	Management and maintenance of the SuDS.	No effect. **(not significant)**.
	Contamination of the river.	Water draining from the site will	Negligible	Management and maintenance	Negligible **(not**

Receptor	Impact	Primary or Tertiary Mitigation.	Assessment of Effects.	Additional Mitigation.	Residual Effects.
		pass through petrol/oil interceptors where necessary.		of the SuDS.	**significant)**.
Existing pond.	Contamination of the controlled waters.		Negligible	Remediation of soil and surface water receptor if necessary.	Negligible **(not significant)**.
Surface water abstraction.	Alteration of flow regime.	Infiltration basin and existing drainage would intercept drainage from the proposed Yoxford roundabout.	No effect.	Longer term surface water monitoring if necessary.	No effect. **(not significant)**.
	Contamination of the river.	Water draining from the site will pass through petrol/oil interceptors where necessary.	Negligible		Negligible **(not significant)**.
Flood risk to surrounding areas	Loss of functional floodplain storage or displacement of sea or river water	Infiltration basin and swales will be incorporated into the design.	No effect.	Not required.	No effect. **(not significant)**.

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