



Anglian Water - Water Resources Management Plan

Habitats Regulations Assessment
Task II: Appropriate Assessment
Final for Publication

December 2019

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Contents

Contents	vi
Non-Technical Summary	1
Table of Abbreviations	3
1 Introduction	5
1.1 Background	5
1.2 The Purpose of the Habitats Regulations Assessment	5
1.3 The Process of Habitats Regulations Assessment	6
1.4 Study Area	8
1.5 Development of WRMP and the HRA Task I: Screening Assessment	8
1.6 Outcome of the Task I: Screening Assessment and Scoping the Task II: Appropriate Assessment	9
1.7 Aims of the Task II: Appropriate Assessment	11
2 Methodology	13
2.1 Approach to the Task II: Appropriate Assessment and Guidance	13
2.2 Identifying a Zone of Influence	13
2.2.1 Identifying Potential Impacts	14
2.2.2 Dealing with Uncertainty	16
2.3 Assessing In-Combination Effects	17
2.4 Scope of the Task II: Appropriate Assessment	17
3 ESU1 - Felixstowe Desalination	19
3.1 Option Description	19
3.2 Designated Sites in the Zone of Influence	20
3.2.1 Stour and Orwell Estuaries SPA	21
3.2.2 Stour and Orwell Estuaries Ramsar site	21
3.2.3 Conservation objectives of the Stour and Orwell Estuaries	22
3.2.4 Vulnerability of the Stour and Orwell Estuaries	22
3.2.5 Deben Estuary SPA and EMS	23
3.2.6 Deben Estuary Ramsar site	23
3.2.7 Conservation Objectives of Deben Estuary	24
3.2.8 Vulnerability of Deben Estuary	24
3.2.9 Outer Thames Estuary SPA	24
3.2.10 Conservation Objectives of Thames Estuary	25
3.2.11 Vulnerability of Outer Thames Estuary	25
3.2.12 Qualifying habitats of the Stour and Orwell Estuaries SPA/Ramsar, Deben Estuary SPA/Ramsar and Outer Thames Estuary SPA within the Zone of Influence	26

3.2.13	Qualifying birds of the Stour and Orwell Estuaries SPA/Ramsar and Deben Estuary SPA/Ramsar within the Zone of Influence	26
3.3	Potential Impacts of ESU1 Felixstowe Desalination	27
3.3.1	Construction Impacts	28
3.3.2	Operation Impacts	29
3.4	Summary of Potential Impacts of the Option	30
3.5	Conclusions and Recommendations	30
3.5.1	Background	30
3.5.2	Summary of Potential Effects on European Sites	31
3.5.3	Proposed Mitigation Measures	31
3.5.4	Summary of HRA Task II: Appropriate Assessment	32
4	SHB2 - Pyewipe Water Reuse for Non-Potable Use	34
4.1	Option Description	34
4.2.1	The Humber Estuary	35
4.2.2	The Humber Estuary SPA	35
4.2.3	Humber Estuary Ramsar site	36
4.2.4	The Humber Estuary SAC	36
4.2.5	Conservation Objectives of the Humber Estuary	37
4.2.6	Vulnerabilities of the Humber Estuary	38
4.2.7	Qualifying habitats of the Humber Estuary within the Zone of Influence	38
4.2.8	Qualifying bird species of the Humber Estuary within the Zone of Influence	39
4.2.9	Qualifying mammal and amphibian species of the Humber Estuary within the Zone of Influence	40
4.2.10	Qualifying fish species of the Humber Estuary within the Zone of Influence	40
4.3	Potential Impacts of SHB2 Pyewipe Water Reuse for Non-Potable Use	40
4.3.1	Construction Effects	41
4.3.2	Operational Effects	43
4.4	Summary of Potential Impacts of the Option	44
4.5	Conclusions and Recommendations	45
4.5.1	Background	45
4.5.2	Summary of Potential Impacts	45
4.5.3	Proposed Mitigation Measures	45
4.5.4	Summary of Task II: Appropriate Assessment	46
5	ESU2 – Ipswich Water Reuse	49
5.1	Option Description	49
5.2	Designated Sites in the Zone of Influence	51
5.2.1	Stour and Orwell Estuaries SPA	51
5.2.2	Stour and Orwell Estuaries Ramsar site	52
5.2.3	Conservation Objectives of the Stour and Orwell Estuaries	52
5.2.4	Vulnerability of the Stour and Orwell Estuaries	53

5.2.5	Qualifying habitats of the Stour and Orwell Estuaries SPA/Ramsar within the Zone of Influence	53
5.2.6	Qualifying bird species of the Stour and Orwell Estuaries within the Zone of Influence	54
5.3	Potential impacts of ESU2 Ipswich Water Reuse	54
5.3.1	Construction effects	55
5.3.2	Operation effects	57
5.4	Summary of Potential Impacts of the Option	58
5.5	Conclusions and Recommendations	59
5.5.1	Background	59
5.5.2	Summary of Potential Effects on European Sites	60
5.5.3	Proposed Mitigation Measures	60
5.5.4	Summary of the Task II: Appropriate Assessment	61
6	NFN1 - Kings Lynn Desalination	63
6.1	Scheme Description	63
6.2	Designated Sites in the Zone of Influence	64
6.2.1	The Wash SPA and EMS	65
6.2.2	The Wash Ramsar site	66
6.2.3	The Wash & North Norfolk Coast SAC	67
6.2.4	Conservation objectives of The Wash	68
6.2.5	Vulnerability of The Wash	68
6.2.6	Qualifying habitats of the Wash SPA/Ramsar site/SAC in the Zone of Influence	69
6.2.7	Qualifying bird species of The Wash SPA/Ramsar site/SAC in the Zone of Influence	69
6.3	Potential Impacts of NFN1 Kings Lynn Desalination	70
6.3.1	Construction impacts	71
6.3.2	Operation impacts	72
6.4	Summary of Potential Impacts of the Option	73
6.5	Conclusions and Recommendations	74
6.5.1	Background	74
6.5.2	Summary of Potential Effects on European Sites	74
6.5.3	Proposed Mitigation Measures	75
6.5.4	Summary of the Task II: Appropriate Assessment	76
7	NFN2 - Kings Lynn Water Reuse	79
7.1	Option Description	79
7.2	Designated Sites in the Zone of Influence	80
7.2.1	The Wash SPA and marine component	81
7.2.2	The Wash Ramsar site	82
7.2.3	The Wash & North Norfolk Coast SAC	83
7.2.4	Conservation Objectives of The Wash	84
7.2.5	Vulnerability of The Wash	84

7.2.6	Qualifying habitats of the Wash SPA/Ramsar site/SAC in the Zone of Influence	85
7.2.7	Qualifying bird species of The Wash SPA/Ramsar site/SAC in the Zone of Influence	85
7.3	Potential Impacts of NFN2 Kings Lynn Water Reuse	86
7.3.1	Construction Impacts	86
7.3.2	Operation impacts	88
7.4	Summary of Potential Impacts of the Option	88
7.5	Conclusions and Recommendations	89
7.5.1	Background	89
7.5.2	Summary of Potential Effects on European Sites	89
7.5.3	Proposed Mitigation Measures	90
7.5.4	Summary of the Task II: Appropriate Assessment	90
8	NFN3 - Fenland Reservoir	93
8.1	Option Description	93
8.2	Designated Sites in the Zone of Influence	94
8.2.1	Ouse Washes SPA	95
8.2.2	Ouse Washes Ramsar site	96
8.2.3	Ouse Washes SAC	97
8.2.4	Conservation Objectives of the Ouse Washes	97
8.2.5	Vulnerabilities of the Ouse Washes	98
8.2.6	Breckland SPA	98
8.2.7	Conservation Objectives of Breckland SPA	99
8.2.8	Vulnerabilities of Breckland SPA	99
8.2.9	Qualifying habitats of the Ouse Washes SPA/Ramsar site/SAC and Breckland SPA within the Zone of Influence	100
8.2.10	Qualifying bird species of the Ouse Washes SPA/Ramsar site/ SAC and Breckland SPA within the Zone of Influence	100
8.2.11	Qualifying fish species of the Ouse Washes SAC within the Zone of Influence	101
8.3	Potential Impacts of the NFN3 Fenland Reservoir option	101
8.3.1	Construction Impacts	102
8.3.2	Operational Impacts	104
8.4	Summary of Potential Impacts of the Option	108
8.5	Conclusions and Recommendations	108
8.5.1	Background	108
8.5.2	Summary of Potential Effects on European Sites	108
8.5.3	Proposed Mitigation Measures	109
8.5.4	Summary of Task II: Appropriate Assessment	110
9	In-Combination Effects Assessment	112
9.1	Intra-Plan Effects	113
9.1.1	In-Combination Effects on The Wash SPA/Ramsar site and The Wash and North Norfolk Coast SAC	113

9.1.2	In-Combination Effects on the Stour and Orwell Estuaries SPA/Ramsar site	113
9.2	Inter-Plan Effects	114
9.2.1	In-combination effects with other WRMPs	114
9.2.2	Anglian Water Drought Plan 2019	116
9.2.3	Water Resources East	117
9.2.4	Environment Agency National Drought Plan	117
9.2.5	River Basin Management Plans 2015	117
9.3	Inter-Project Effects	118
10	Summary of WRMP HRA Task II: Appropriate Assessment	119
10.1	Summary of the Task II: Appropriate Assessment	119
10.2	Summary of In-Combination Effects Assessment	121
10.3	Overall Conclusion of WRMP HRA	122
11	References	123
	Appendices	126
A.	Description of European Site Qualifying Features in the Anglian Region	127
B.	Maps of Options and European Sites	128
C.	Removed Options Assessments	129
D.	Consultation Log	130

Non-Technical Summary

Water companies have a statutory obligation to produce a Water Resources Management Plan (WRMP), which sets out how a company intends to maintain the balance between supply and demand for water over a minimum 25-year period. Mott MacDonald was commissioned by Anglian Water to undertake a Habitats Regulations Assessment (HRA) of its WRMP.

The HRA Task I: Screening Assessment identified six options that had the potential to result in Likely Significant Effects on European sites. These were:

- ESU1 Felixstowe Desalination;
- SHB2 Pyewipe Water Reuse for Non-Potable Use;
- ESU2 Ipswich Water Reuse;
- NFN1 Kings Lynn Desalination;
- NFN2 Kings Lynn Water Reuse;
- NFN3 Fenland Reservoir.

This report details the Task II: Appropriate Assessments undertaken, to assess whether these options were likely to adversely affect the integrity of the potentially affected European sites.

For the two desalination options (ESU1 - Felixstowe and NFN1 – Kings Lynn), it was concluded that the level of design for the strategic plan does not allow a comprehensive conclusion in relation to identifying adverse effects on European sites. The effects of the impacts identified during operation (i.e. potential increase in salinity as a result of brine discharge) will need to be explored further at the project level or lower tier HRA in order to demonstrate that the integrity of European sites will not be significantly adversely affected. At the strategic level of the WRMP however, the assessment undertaken still allows confidence that the option could be implemented with no residual effects on European sites, subject to the development of a mitigation strategy once final detailed design is available and implications of brine discharge are fully understood.

For the remaining four options identified in the Task I: Screening Assessment (SHB2 Pyewipe Water Reuse, ESU2 Ipswich Water Reuse, NFN2 Kings Lynn Water Reuse and NFN3 Fenland Reservoir); appropriate mitigation measures have been identified in the Task II: Appropriate Assessment to ensure that the integrity of the European sites identified will not be adversely affected as a result of construction or operation.

The potential for the WRMP to act in-combination to result in cumulative effects in European sites has been explored and the assessment has identified two European sites that may be affected in-combination with the implementation of the adaptive strategy, but it is reasonably assumed that the identified cumulative impacts can be mitigated fully and will therefore result in no residual effects, either alone or in-combination from the adaptive plan.

The potential for Anglian Waters WRMP to act in-combination with neighbouring Water Company's WRMPs was preliminary assessed and no European sites have been identified with the potential to be affected in-combination with the Anglian Water WRMP, but it is noted that the final WRMPs may include options that will need to be relooked at, at the project-level or lower tier HRA.

The conclusion of this assessment is consistent with the Habitats Regulations but highlights the importance of lower tier project-level assessments or future plans, projects, or permissions

which may act in-combination with WRMP options to refine mitigation strategies and assessment conclusions once appropriate detailed design is available.

Table of Abbreviations

Acronym

AA	Appropriate Assessment
ASR	Aquifer Storage Recovery
AWS	Anglian Water Services
DCLG	Department for Communities and Local Government
EA	Environment Agency
EBSD	Economics of Balancing Supply and Demand
EC	European Commission
EQS	Environmental Quality Standards
EU	European Union
HoF	Hands off Flow
HRA	Habitats Regulations Assessment
IROPI	Imperative Reasons for Overriding Public Interest
LA	Local Authority
LDF	Local Development Framework
LNR	Local Nature Reserve
LPA	Local Planning Authority
LSE	Likely Significant Effects
NE	Natural England
NIEA	Northern Ireland Environment Agency
NNR	National Nature Reserve
NRW	Natural Resources Wales
RIS	Ramsar Information Sheet
RO	Reverse Osmosis
RoC	Review of Consents
RZ	Resource Zone
SAC	Special Area of Conservation
SCI	Site of Community Importance
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SIP	Site Improvement Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
ToLS	Test of Likely Significance
UK	United Kingdom
UKWIR	United Kingdom Water Industry Research
WFD	Water Framework Directive
WR	Water Reservoir
WRC	Water Recycling Centre
WRMP	Water Resource Management Plan
WRPG	Water Resource Planning Guidelines
WRTW	Water Reuse Treatment Works
WRZ	Water Resource Zone
WT	Water Tower

AA	Appropriate Assessment
WTW	Water Treatment Works
Zol	Zone of Influence

1 Introduction

1.1 Background

Water companies have a statutory obligation to produce a Water Resources Management Plan (WRMP), which sets out how a company intends to maintain the balance between supply and demand for water over a minimum 25-year period. In the development of a WRMP, companies must follow the Water Resource Planning (WRP) Guidelines¹ and have regard to broader government policy objectives, as set out in Defra's Guiding Principles², for example. WRMPs should ensure a secure and sustainable supply of water and focus on efficiently delivering customer outcomes while reflecting the value that society places on the environment.

Mott MacDonald was commissioned by Anglian Water to undertake a Habitats Regulations Assessment (HRA) of its WRMP. Under the European Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (also known as the 'Habitats Directive') and the resulting Conservation of Habitats and Species Regulations 2017 (SI 2017/1012), competent authorities are required to assess the potential impact of plans and programmes to ensure that there will not be any adverse effects on sites of European nature conservation importance ('European sites'). The process by which the impacts of a plan or programme are assessed against the conservation objectives of a European site is called a Habitats Regulations Assessment.

This report presents the HRA Task II: Appropriate Assessment of the WRMP. A Task II assessment was only undertaken on those options which were selected for the Preferred Plan and adaptive strategy for the WRMP, and on which the Task I: Screening assessment identified potential for adverse effects on a European site.

1.2 The Purpose of the Habitats Regulations Assessment

In accordance with Article 6(3) of the Habitats Directive, 'Article 6 Assessments' are required where a plan not directly connected with or necessary to the management of a European site(s), may give rise to significant effects upon a European site(s). The requirement for Article 6 Assessments has been transposed into UK law under Regulation 63(1) of the Conservation of Habitats and Species Regulations 2017 ('Habitats Regulations') (S.I. 2017/1012) and is commonly referred to as a 'Habitats Regulations Assessment' (HRA) or an 'Appropriate Assessment' (AA). 'Appropriate Assessment' is taken to mean an assessment which is 'appropriate to its purpose under the Habitats Directive and Habitats Regulations' and is not to be confused with the second of the Article 6 Assessments with the same name³.

It should be noted that WRMPs are not explicitly included within Regulation 63 of the Habitats Regulations, but it is suggested that all WRMPs should be subject to HRA screening to

¹ Environment Agency, Natural Resources Wales, Defra & OFWAT (2016). *Final Water Resources Planning Guideline*.

² Defra's Guiding Principles set out the government objective 'to deliver secure, reliable, sustainable and affordable supplies of water, value nature in decision-making and connect people with the environment'². They encourage water companies to act as 'leaders' and 'stewards' of the natural environment, to use the WRMP process as an opportunity to connect communities to their local environment and to reflect the value of the environment in decision making by using natural capital (and ecosystems services) approaches². Defra (May 2016). *Guiding Principles for Water Resource Planning*. Page 1&4

³ Department for Communities and Local Government (DCLG) (2006). *Planning for the Protection of European Sites: Appropriate Assessment Under The Conservation (Natural Habitats, &C) (Amendment) (England and Wales) Regulations 2006*. Guidance For Regional Spatial Strategies. [online] Available at: <http://www.communities.gov.uk/documents/planningandbuilding/pdf/160442.pdf> [Accessed 6th June 2017].

determine whether they could have adverse effects on one or more European sites (alone and in combination with other plans). The Environment Agency confirms this position in Sections 3.1 and 6.7 of the Water Resources Planning Guidelines⁴, stating that the requirement for HRA should extend to such draft plans or similar developmental stages. As with the process of SEA, it is accepted best-practice for HRA of strategic planning documents to run as an iterative process alongside the plan, with the options continually assessed for their possible effects on sites of European nature conservation importance. This allows options to be scoped out or modified as necessary to ensure that the final adopted WRMP is not likely to result in adverse effects on any European sites (alone and in combination with other plans).

European sites of nature conservation importance include Special Protection Areas (SPAs), Special Areas for Conservation (SACs), candidate SACs and proposed SPAs, as well as Sites of Community Importance (SCIs) which have been adopted by the EC, but not yet formally designated by the government of a Member State. In the UK, Ramsar wetland sites of international importance are also required to undergo an assessment when a plan is considered likely to have a significant effect upon them⁵. For the purposes of this assessment, European sites of nature conservation importance and Ramsar wetland sites of international importance will be collectively referred to as 'European sites' in this report. It should be noted that conservation areas designated at a national or local level (such as Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs)) do not fall under the scope of a HRA, and any potential impacts on these sites were assessed in the SEA.

Before deciding to undertake a plan that may give rise to significant effects upon a European site (that is not directly connected with or necessary to the management of that site), a Competent Authority must make an assessment of the implications for that site in view of its conservation objectives. The Habitats Regulations require every Competent Authority, in the exercise of any of its functions, to have regard to the requirements of the Habitats Directive. Water Companies have a statutory duty to prepare WRMPs; therefore, Anglian Water are considered to be the Competent Authority under Part 6 of the Habitats Regulations. The Competent Authority must also consult with the appropriate nature conservation body (i.e. Natural England (NE)) and have regard to any representations made by that body.

1.3 The Process of Habitats Regulations Assessment

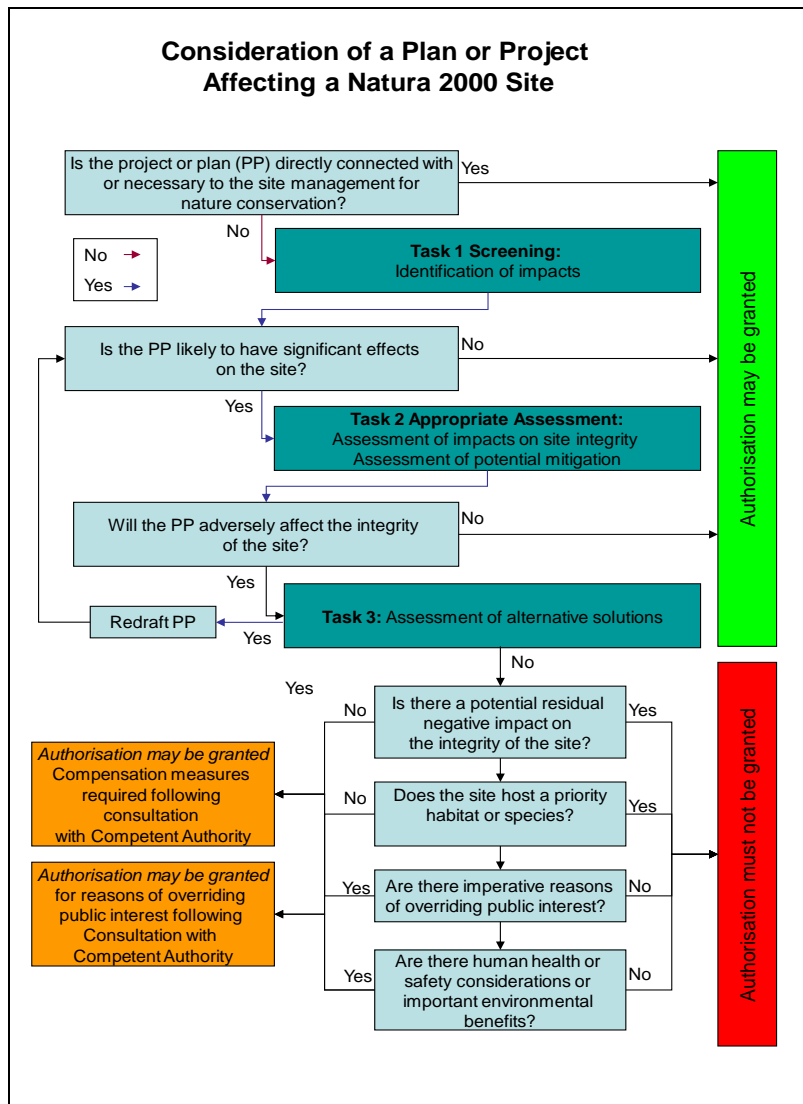
The HRA for the assessment of a plan is undertaken in a series of tasks⁶ (see Figure 1). These tasks correspond with the Article 6 Assessments prescribed by the Habitats Directive. Each task determines whether further tasks in the process are required.

⁴ Environment Agency, Natural Resources Wales, Defra & OFWAT (2016). Final Water Resources Planning Guideline. Available at: <https://naturalresources.wales/media/678424/ea-nrw-and-defra-wg-ofwat-technical-water-resources-planning-guidelines.pdf> [Accessed 6th June 2017].

⁵ Department for Environment, Food and Rural Affairs (Defra) (2006). *Ramsar sites in England – A policy statement*. [online] Available at: <http://archive.defra.gov.uk/rural/documents/protected/ramsar-policy.pdf> [Accessed 6th June 2017].

⁶ Department for Communities and Local Government (DCLG) (2006). *Planning for the Protection of European Sites: Appropriate Assessment Under The Conservation (Natural Habitats, &C) (Amendment) (England and Wales) Regulations 2006*. Guidance For Regional Spatial Strategies. [online] Available at: <http://www.communities.gov.uk/documents/planningandbuilding/pdf/160442.pdf> [Accessed 6th June 2017]

Figure 1: The Habitats Regulations Assessment process



NB: The term 'Task' is used in reference to an assessment of a plan ⁷

Task I is the screening stage (hereafter called 'Task I: Screening') and identified the components of the plan (i.e. the options) that have *the potential* to result in adverse effects on European sites. Options were screened in using a precautionary approach – i.e. if reasonable impact pathways⁸ were identified to a European site then it was considered there was potential for the option to result in adverse effects. The screening did not take into account any mitigation that will be applied thereafter. If the conclusion of Task I: Screening was that there will be no potential adverse effects on the European site, there is no requirement to undertake further tasks. If the conclusion of Task I: Screening was that the option has the potential to result in adverse effects, then the option has been brought forward to Task II.

⁷ Department for Communities and Local Government (DCLG) (2006). Planning for the Protection of European Sites: Appropriate Assessment Under the Conservation (Natural Habitats, &C) (Amendment) (England and Wales) Regulations 2006. Available at: www.communities.gov.uk/documents/planningandbuilding/pdf/160442.pdf [Accessed 6th June 2017]

⁸ Briefly defined, an impact pathway is considered any route by which a change in activity as a result of the implementation of the option can lead to an effect upon a European site.

Task II (Appropriate Assessment) was applied to the options which were included on the WRMP that resulted in having potential for Likely Significant Effects in the Task I: Screening. Where an option was screened in as having potential to give rise to adverse effects on the European site, an assessment was made of the implications on the integrity of that site, considering the site's structure, function, and conservation objectives. Furthermore, where adverse impacts were identified, an assessment of whether there is potential for the impacts to be appropriately mitigated is also given.

If the Task II AA concluded that adverse effects were likely to remain after mitigation, there must be an examination of alternative ways to complete the plan that avoids adverse impacts on the integrity of the site (**Task III**). Where alternatives exist, these should be subjected to Task I and/or Task II assessments. Where no alternatives exist, it is necessary under Article 6(4) of the Habitats Directive to identify if there are, or are not, imperative reasons for overriding public interest (IROPI). If there are IROPI then compensatory measures must be assessed (**Task IV**). In making this assessment, it is important to recognise that it should be appropriate to the likely scale, importance, and impact of the plan.

1.4 Study Area

The area covered by the Anglian Water WRMP is the East Anglia region; west from Chipping Warden, north to Hull, South to Chelmsford and east to the coast. It supports large proportions of England's wetland and coastal habitats as well as some of the UK's rarest habitats and species, including agricultural landscapes, ancient woodland, heathlands, rivers, and low-lying coasts.

Within the WRMP area (and a surrounding 10km buffer), there are 40 SACs, 28 SPAs and 28 Ramsar wetlands of International importance. These are listed and shown on a corresponding map in Appendix B. Each European site is classified based upon the qualifying features it supports; these are described in Appendix A.

1.5 Development of WRMP and the HRA Task I: Screening Assessment

As a precursor to the HRA and SEA, Mott MacDonald undertook a high level environmental screening exercise of the 'unconstrained' options list, refined from a generic list of potential measures to meet water demand provided by AWS. The screening process highlighted environmental risks and constraints, including a high-level assessment of potential effects on European sites as well as a number of other receptors, and resulted in the rejection or amendment of certain options to produce the WRMP 'constrained' options list⁹ (see the WRMP 2019 SEA Scoping Report¹⁰ for further details about the high level environmental screening process).

The constrained list was then subject to a feasibility study to produce a set of options considered to be suitable to take forward for assessment as part of the WRMP development called the 'feasible list' of options¹¹. A HRA Task I: Screening assessment was undertaken on the feasible list of options as of June 2017.

⁹ The WRMP process generally starts with a generic of potential types of measures to meet water demand which is refined into an 'unconstrained list'. The unconstrained list is then screened using professional judgement to remove impractical options, leaving the 'constrained list' (UKWIR, 2012, 'Strategic Environmental Assessment and Habitats Regulations Assessment – Guidance for Water Resources Management Plans and Drought Plans', Page 26.

¹⁰ Mott MacDonald (2017). *Anglian Water WRMP 2019 SEA Scoping Report*. Mott MacDonald, April 2017

¹¹ The 'feasible list' is a sub-set of the 'constrained list' following options feasibility studies. It is a set of options considered to be suitable to take forward for assessment as part of the preferred programme options. As such it should not include options with

The Draft WRMP was published for consultation in March 2018, allowing interested stakeholders and customers to review and comment upon the proposals. The feedback received from the consultation process played a significant role in shaping the WRMP. The Task II: Appropriate Assessments of the options included in the Draft WRMP that did not appear in the WRMP are presented in Appendix C of this report.

As part of the WRMP development from Draft to WRMP, options were further refined. For example, where the option was assessed and potential effects on environmental features were identified, these have been altered through the options design process where possible; by re-routing pipelines or by the use of directional drilling under sensitive sites and rivers as a design feature. Where changes were made to design, these options were re-screened at the HRA Task I: Screening stage, and it was the final option design assessments that are given in the WRMP HRA Task I: Screening report¹².

Traditionally, Water Companies have used the Economics of Balancing Supply and Demand (EBS D) approach to guide decision making, resulting in a 'least cost' solution. The limitations of a least cost planning approach are now widely recognised, and there is support from regulators, stakeholders and customers, to develop best value plans. When moving from the Least Cost Plan to the Best Value Plan a number of factors were evaluated including: cost; adaptability and flexibility; alignment to WRE; risk and resilience; customer preferences; and environmental and social impacts. The Preferred Plan also includes an adaptive strategy to deal with uncertainties and future scenarios which identifies thresholds beyond which Anglian Water currently need to take further action.

It should be noted that the Task I: Screening process used the 'precautionary approach' – i.e. if there was doubt and further information was required, it was concluded that there was potential for LSE to occur. An effect is considered to have potential LSE if there is a possibility for adverse impacts on the qualifying features of the European site, or if it undermines its integrity. Mitigation was not considered at the Task I: Screening stage, as per the recent Court of Justice of the European Union ruling in the matter of People Over Wind and Sweetman v Coillte Teoranta (C-323/17) in relation to the application of mitigation measures and Article 6(3) of the Habitats Directive, which concluded that measures to mitigate the harmful effects of a plan or project must only be made at the Task II: Appropriate Assessment stage.

1.6 Outcome of the Task I: Screening Assessment and Scoping the Task II: Appropriate Assessment

The results of the HRA Task I: Screening assessment for the WRMP is given in Table 1 and Table 2.

Two options within the Preferred Plan were assessed as having Likely Significant Effects on European sites:

- ESU1 Felixstowe Desalination
- SHB2 Pyewipe Water Reuse for non-potable

Five options included in the adaptive strategy were assessed as having Likely Significant Effects on European sites:

- ESU1 Felixstowe Desalination

unalterable constraints that make them unsuitable for promotion e.g. unacceptable environmental impacts that cannot be overcome. (EA, NRW, Defra and Ofwat, 2016, 'Final Water Resources Planning Guideline', Page 29).

¹² Mott MacDonald (2018) Anglian Water Final WRMP 2019 Habitats Regulations Assessment Task I: Screening Report. Mott MacDonald, 2018.

- ESU2 Ipswich Water Reuse
- NFN1 Kings Lynn Desalination
- NFN2 Kings Lynn Water Reuse
- NFN3 Fenland New Reservoir

For the options where the Task I: Screening assessment identified no potential for Likely Significant Effects on European sites, the screening outcome was considered final, and the option was not assessed further at the Appropriate Assessment stage. For the options that resulted in 'potential Likely Significant Effects'; the Task II: Appropriate Assessments for these options forms the basis of this report.

Table 1: Preferred Plan HRA Task I: Screening assessment summary

Option ref.	Option name	WRZ	Potential for Significant Effects on a European Site?
-	Demand Management Strategy Extended Plus	All	No
BHV5	Newmarket RZ to Bury Haverhill RZ Transfer (20MI/d)	Bury Haverhill	No
CLN13a	South Humber Bank RZ to Central Lincolnshire RZ Transfer (31MI/d)	Central Lincolnshire	No
CLN14	South Humber Bank RZ to Central Lincolnshire RZ Transfer (6MI/d)	Central Lincolnshire	No
CLN15	South Humber Bank RZ to Central Lincolnshire RZ Transfer (Existing)	Central Lincolnshire	No
CLN16	South Humber Bank RZ to Central Lincolnshire RZ Transfer	Central Lincolnshire	No
ELY9	North Fenland RZ to Ely RZ Transfer (20MI/d)	Ely	No
CVY1	Newmarket RZ to Cheveley RZ Transfer	Cheveley	No
ESU1	Felixstowe Desalination	East Suffolk	Yes – Stour and Orwell Estuaries SPA Deben Estuary SPA
ESU8	Bury Haverhill RZ to East Suffolk RZ transfer (20MI/d)	East Suffolk	No
HPB1	Norwich & the Broads RZ to Happisburgh RZ Transfer	Happisburgh	No
HPB2	Norwich & the Broads WRZ to Happisburgh Transfer (East Ruston/Witton)	Happisburgh	No
NFN4	South Fenland RZ to North Fenland RZ Transfer (20MI/d)	North Fenland	No
NNR8	Norwich & the Broads RZ to Norfolk Rural North RZ Transfer (5MI/d)	Norfolk Rural North	No
NWM6	Ely RZ to Newmarket RZ Transfer (20MI/d)	Newmarket	No
NTM1	Central Lincolnshire RZ to Nottinghamshire RZ Transfer	Nottinghamshire	No
RTC2	Ruthamford South RZ to Ruthamford Central RZ Transfer	Ruthamford Central	No
RTN27	South Lincolnshire RZ to Ruthamford North RZ (67MI/d)	Ruthamford North	No
SEX4	East Suffolk RZ to South Essex RZ transfer (15MI/d)	South Essex	No

Option ref.	Option name	WRZ	Potential for Significant Effects on a European Site?
SFN4	Ruthamford North RZ to South Fenland RZ Transfer (40 MI/d)	South Fenland	No
SHB2	Pyewipe Water Reuse for non-potable use	South Humber Bank	Yes – Humber Estuary SPA/Ramsar site/SAC
SLN6	Central Lincolnshire RZ to South Lincolnshire RZ Transfer (63MI/d)	South Lincolnshire	No
THT1	Bury Haverhill to Thetford transfer	Thetford	No
-	Birchmoor WTW Resilience	Ruthamford South	No
-	Meppershall WTW Resilience	Ruthamford South	No
-	Diddlington WTW Resilience	Norfolk Rural North	No
-	Great Wratting WTW Resilience	Bury Haverhill	No

Table 2: Adaptive strategy HRA Task I: Screening assessment summary

Option ref.	Option name	WRZ	
ESU1	Felixstowe Desalination	East Suffolk	Yes – Stour and Orwell Estuaries SPA Deben Estuary SPA
ESU2	Ipswich Water Reuse	East Suffolk	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar site
NFN1	Kings Lynn Desalination	North Fenland	Yes – The Wash SPA/Ramsar site The Wash and North Norfolk Coast SAC
NFN2	Kings Lynn Water Reuse	North Fenland	Yes – The Wash SPA/Ramsar site The Wash and North Norfolk Coast SAC
NFN3	Fenland Reservoir	North Fenland	Yes – Ouse Washes SPA/Ramsar site/SAC Norfolk Valley Fens SAC Breckland SPA/SAC Barnack Hills and Holes SAC
RTN1	South Lincolnshire Reservoir (unsupported)	Ruthamford North	No
RTN2	South Lincolnshire Reservoir (supported)	Ruthamford North	No
RTN6 / RTN7	Severn Trent water Import	Ruthamford North	No

1.7 Aims of the Task II: Appropriate Assessment

The Task II: Appropriate Assessment aims to determine, in more detail, the impact of the WRMP on the integrity of the European sites, with respect to the site's structure, function and conservation objectives.

The WRMP is a strategic-level plan, therefore finalised detailed design is not yet available for each option, and no empirical data has been recorded in the form of field surveys or otherwise to inform the assessment specific to each option. This will be carried out at the project-stage where necessary and will be accompanied by a project-level lower-tier Appropriate Assessment where adverse effects on European sites cannot be ruled out through the assessment made in this document, or otherwise. This assessment therefore aims to clarify potential source-

pathway-receptor linkages from the WRMP to European sites and assess the potential for appropriate mitigation where potential adverse impacts are identified.

2 Methodology

2.1 Approach to the Task II: Appropriate Assessment and Guidance

In conducting this Task II: Appropriate Assessment, the impact of WRMP (either alone or in combination with other projects or plans) on the integrity of the European sites was considered with respect to the conservation objectives of the sites and their structure and function. For each of the options screened in during the Task I: Screening assessment, the following steps have been undertaken and detailed within this appropriate assessment:

- Compilation of all available information on the option, including characteristics of the proposed option, specifications, duration of works and relationship to European sites.
- Assessment of the European sites' characteristics and identification of their conservation objectives.
- Prediction of impacts from each option, with a focus on the potential impacts included in UK Water Industry Research guidance¹³ and detailed in Table 4 below.
- Assessment of whether the options have the potential to result in adverse effects on the integrity of European sites, as defined by their conservation objectives and status.
- Identification of appropriate mitigation measures to avoid adverse effects if level of design detail allows.
- Summary of outcomes from the Appropriate Assessment for each option, including an outcomes table outlining qualifying features of the European sites from which adverse impacts cannot be excluded; adverse impacts can be excluded; or adverse impacts can likely be excluded following recommended mitigation measures or following further assessment at project-stage.

These steps have been taken in accordance with methodological guidance on the assessment of plans and projects affecting European sites, as published by the European Commission¹⁴ and in accordance with the following guidelines:

- UK Water Industry Research (2012). *Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans (12/WR/02/7)*.
- English Nature (1997-2001). *Habitats Regulations Guidance Notes 1-9*, Natural England, Peterborough.
- European Commission (2001). *Assessment of plans and projects significantly affecting European sites*. European Commission, Brussels.
- European Communities (2007). *Managing European sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC*. European Commission, Brussels.

2.2 Identifying a Zone of Influence

The options were screened using electronic maps of assets provided by Anglian Water and developed by Mott MacDonald through GIS. The variation in the potential impacts between different types of options within the WRMP can be significant. Such variation is related to the

¹³ UKWIR (2012). *Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans (12/WR/02/7)*. UK Water Industry Research (2012).

¹⁴ European Commission (2002). *Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*. European Commission, Brussels

geographic and temporal scale of construction phases, the degree of hydrological connectivity with European sites and the sensitivity of features within the European sites. As a result of this potential variation, option specific buffers (or Zones of Influence (Zols)) were created around the option types, in which European sites have the potential to be affected. The defined Zols for the option types considered in this report are given in Table 3.

Table 3: Zone of Influence defined for each option type

Option Type	Zone of Influence	
Desalination	5km	
Reservoirs	New reservoir	500m
	Increase capacity raising/dredging	500m
	Increase yield/intakes/improve efficiency	5km from source
Water (effluent) reuse from discharge	5km	
	Construction of	500m
Associated transfers	Changes in abstraction regime	Downstream to where watercourse enters estuarine or coastal waters

It should be noted that these Zols were not explicitly adhered to and in practice, all European sites that were within 15km or directly downstream of an option were looked at, with sites beyond this considered on an option-by-option basis depending on the site interest features and how the option would function. This is considered to be a suitably precautionary approach. It was appropriate to use a larger Zol than defined above, for example, where increased abstraction has the potential to affect downstream sites in the catchment, or where an affected waterbody feeds into a European site downstream of the Zol. Where a larger Zol is considered, this is described in the assessment given.

It should be noted that for alterations to current abstractions, only effects on European sites as a result of *new* abstractions are considered as causing potential adverse effects. For increases to *current* abstractions, it is assumed that the increased abstraction is still within the current licence limits and therefore unlikely to result in adverse effects on designated sites, as they are protected by the Environment Agency's Review of Consents process. This is discussed further in Section 5.3.

2.2.1 Identifying Potential Impacts

Depending on the nature and magnitude of the proposed options and the sensitivity of the qualifying features of the European sites, the potential resulting impacts may vary. A summary of the potential impacts considered in this assessment is provided in Table 4.

Table 4: Potential impacts considered in this assessment

Broad categories of potential impacts on European sites (with examples)	Examples of operations resulting in impacts
Physical loss Destruction (including offsite effects) e.g. foraging habitat, smothering	Development of built infrastructure associated with the option, e.g. pipelines, temporary weirs, access routes. Physical loss is only likely to be significant where the boundary of the option extends within the boundary of the European site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated).
Physical damage Habitat degradation Erosion Trampling Fragmentation Severance/barrier effects Edge effects	Development of built infrastructure associated with the option, e.g. reservoir embankments, water treatment plants, pipelines, pumping stations. Recreation e.g. cycling, walking, horse-riding, water-sports associated with option benefits e.g. reservoirs. Physical damage is only likely to be significant where the boundary of the option extends within or is directly adjacent to the boundary of the European site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated).
Non-physical disturbance Noise Visual presence Light pollution	Noise from vehicular traffic during construction of the option. Noise from construction traffic is only likely to be significant where the transport route to and from the option is within 500m of the boundary of the European site. Plant and personnel involved in construction and operation of the option e.g. for maintenance plus non-operational activities such as recreation associated with option e.g. reservoirs. These effects (noise visual /human presence) are only likely to be significant where the boundary of the option is within 500m of the boundary of the European site or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated). Development of built infrastructure associated with the option, which includes artificial lighting. Effects from light pollution are only likely to be significant where the boundary of the option is within 500m of the boundary of the European site. From a review of Environment Agency internal guidance on HRA and various websites it is considered that effects of vibration and noise and light are more likely to be significant if development is within 500m of a European site.
Water table/ availability Drying Flooding/storm water Changes to surface water levels and flows Changes to groundwater level and flows Changes to coastal water movement	Change to water levels and flows due to water abstraction, storage and drainage interception associated with inland options. These effects are only likely to be significant where the boundary of the option extends within the same ground or surface water catchment as the European site. However, these effects are dependent on hydrological continuity between the option and the European site, and sometimes, whether the option is up or downstream from the European site.
Toxic contamination Water pollution Soil contamination Air pollution	Air emissions associated with vehicular traffic during construction of options. This effect is only likely to be significant where the transport route to and from the option is within 200 metres of the boundary of the European site. Water pollution only likely to be significant where the boundary of the option extends within the same ground or surface water catchment as the European site. However, these effects are dependent on hydrological continuity between the option and the European site, and if applicable, whether the option is up or downstream from the European site. Soil contamination is only considered likely to be significant where the boundary of the option extends into the European site.
Non-toxic contamination Nutrient enrichment (e.g. of soils and water) Algal blooms Changes in salinity Changes in thermal regime Changes in turbidity Changes in sedimentation/silting Air pollution (dust)	Changes to water salinity, nutrient levels, turbidity, thermal regime due to water abstraction, storage, or inter-catchment transfers. These effects are only likely to be of significance where the boundary of the option extends within the same ground or surface water catchment as the European site. However, these effects are dependent on hydrological continuity between the option and the European site. This level of information is not available until data such as groundwater modelling is collected to accompany planning applications. Emissions of dust during the earthworks, construction of plant and tunnel/pipeline construction associated with options.

Broad categories of potential impacts on European sites (with examples)

Examples of operations resulting in impacts

Biological Disturbances	Potential for changes to habitat availability, e.g. reductions in wetted width of rivers leading to desiccation of macrophyte beds due to changes in abstraction or reduced compensation flow.
Direct mortality	
Changes to habitat availability	
Out-competition by non-native species	This effect is only likely to be significant where the receiving water for the option is the European site or a tributary of the European site.
Selective extraction of species	
Introduction of disease	
Introduction of invasive species	
Rapid population fluctuations	
Natural succession	

Source: Adapted from: UK Water Industry Research (2012)¹⁵.

The WRMP options could affect a European site through the construction process (for example new reservoir creation, construction of new pipelines, construction of new water sites) or operation of the option (e.g. permanent increase in disturbance, increase and/or new abstractions, permanent land-use changes). Both direct (activities that affect a European site directly; for example, construction of a new intake within an SPA reservoir; discharges to an SAC from a desalination plant; new or increased abstractions from an SAC river) and indirect (activities that affect a European site indirectly through an impact pathway; for example, construction affecting a downstream SAC through sediment release; new abstractions entraining SAC fish species away from the SAC itself) impacts are considered.

2.2.2 Dealing with Uncertainty

Due to its wide geographic scale and long-term outlook, there are a large number of uncertainties within the WRMP. With strategy-level HRAs, uncertainty is sometimes addressed by including caveats or mitigation as an assumption to the plan (and therefore all the plan components) to ensure that adverse effects will not occur. This approach has been difficult to apply to the WRMP, as its strategic nature creates fundamental uncertainty in the detailed option information with limited option development available at the time of the HRA. This means that *potential* effects on European sites have been much easier to predict (based on the known option information, i.e. the nature of the broad option type, the location of the option, the identification of a viable pathway, the known sensitivities of the interest features), but much harder to quantify and assess.

To minimise assumptions made on the back of uncertainty, the Task I: Screening used a precautionary approach by screening all uncertainties as having the potential to result in adverse effects and by not considering mitigation which could be applied to reduce the impact of the option. Where an option was screened in as having potential adverse effects based on uncertainty, this option was brought forward to Task II if it was included as part of the planning solutions. At the Task II: Appropriate Assessment stage, an attempt has been made to address the potential impacts in further detail, until that uncertainty can be resolved. If resolution has not been possible, a discussion of appropriate mitigation that has the potential to remove the uncertainty is given. If it is concluded that adverse effects may still remain after the application of appropriate mitigation, then it will be recommended that the option will be subject to further assessment through a project-stage HRA based on detailed design and appropriate collection of further data.

¹⁵ UK WIR (2012). *Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans (12/WR/02/7)*. UK Water Industry Research (2012).

The precautionary principle has continued to be applied within this assessment, with adverse effects assumed if information or evidence is lacking to conclude otherwise. It is important to note that baselines to determine the likely presence of qualifying features within the Zol have been based on a review of literature and aerial imagery, with no site-specific surveys undertaken. Features have been assumed to be present where they could not be excluded with certainty; however, if these options are brought forward for implementation, site visits may allow some precautionary conclusions to be scoped out.

2.3 Assessing In-Combination Effects

The process of HRA requires that the potential effects of other projects, plans or options be considered 'in-combination' with the potential effects of the WRMP. In-combination effects refer to cumulative effects caused by the planning solutions that are currently under consideration together with the effects of any existing or proposed projects or plans, so that it can be established whether there may be an overall significant effect on the integrity of a European site.

The guidance is limited in its definition of an in-combination effect, therefore broadly it is considered that the WRMP could have the following in-combination effects:

1. Effects within the current plan - i.e. separate options within the WRMP affecting the same European site(s)
2. Effects between plans - i.e. effects with other abstractions, in association with or driven by other plans (for example, Anglian Waters Drought Plan or other Water Company WRMPs which border the Anglian Water region)
3. In-combination water resource effects from the Environment Agency Review of Consents process
4. In-combination effects with Local Planning Authority Local Plans or Local Development Frameworks (LDFs)

It should be noted that a comprehensive in-combination assessment is not possible at the stage of development of WRMP, and many of the plans and projects that would require assessment for in-combination effects are still in their draft stages (for example neighbouring Water Company's WRMPs and Drought Plans). The WRMP and its options have been assessed at a high strategic level, and the options that form the WRMP will be subject to the formal planning process prior to implementation, including an Environmental Impact Assessment and a project-level HRA assessment. Requirements for EIA will be determined on an option by option basis. The large supply options proposed under the adaptive strategy (e.g. new reservoirs and desalination plants) may be classified as 'Nationally Significant Infrastructure' and would therefore be required to go through the Development Consent Order planning route, which would itself require its own project-level HRA assessment.

It is assumed, therefore, that in-combination effects will be fully assessed at the project-stage – i.e. pre-implementation of the specific options when detailed design is available and further to the publication of WRMP reports. As part of these processes more detailed design information will be developed and it is assumed that any potential significant effects on European sites due to individual options, or in-combination effects will be avoided as far as reasonably possible.

2.4 Scope of the Task II: Appropriate Assessment

If the Task II: Appropriate Assessment identifies that the options contained in the WRMP will not lead to adverse impacts on the integrity of the European site (as defined by the conservation

objectives and status of the site), this report forms the final assessment and will be issued for consultation alongside the WRMP.

If after the Task II: Appropriate Assessment, options that may result in adverse impacts on the qualifying features of a European site are still considered for the WRMP, they will undoubtedly be subject to a further HRA at the project level, when detailed design of the option is available and an impact assessment informed by appropriate survey if possible. Ultimately no options that will result in residual effects (either alone or in-combination) will be implemented as part of the WRMP.

The HRA Task II: Appropriate Assessments for WRMP are given in the following chapters.

It should be noted that for the Draft WRMP, full HRA assessments (Task I and Task II) of all options was undertaken. The Task II: Appropriate Assessments of the options included in the draft WRMP that did not appear in the WRMP are given in Appendix C of this report.

3 ESU1 - Felixstowe Desalination

3.1 Option Description

The Felixstowe option is situated within the area of the Port of Felixstowe in Suffolk.

The Felixstowe desalination option is a seawater desalination option. It would involve taking water from the North Sea via a new intake pipeline (250-500m offshore) to a new desalination plant. After the desalination process which also includes water treatment, the water will be pumped approximately 5km via a new transfer pipeline to the existing Sprites Hall water reservoir. The water will then be transferred to the existing Rushmere water reservoir by a new 12km transfer pipeline. After this the water is immediately available for distribution in the potable network. The expected benefit is 13MI/d.

The brine outfall from the Felixstowe Desalination Plant is returned to the North Sea via an outfall pipe.

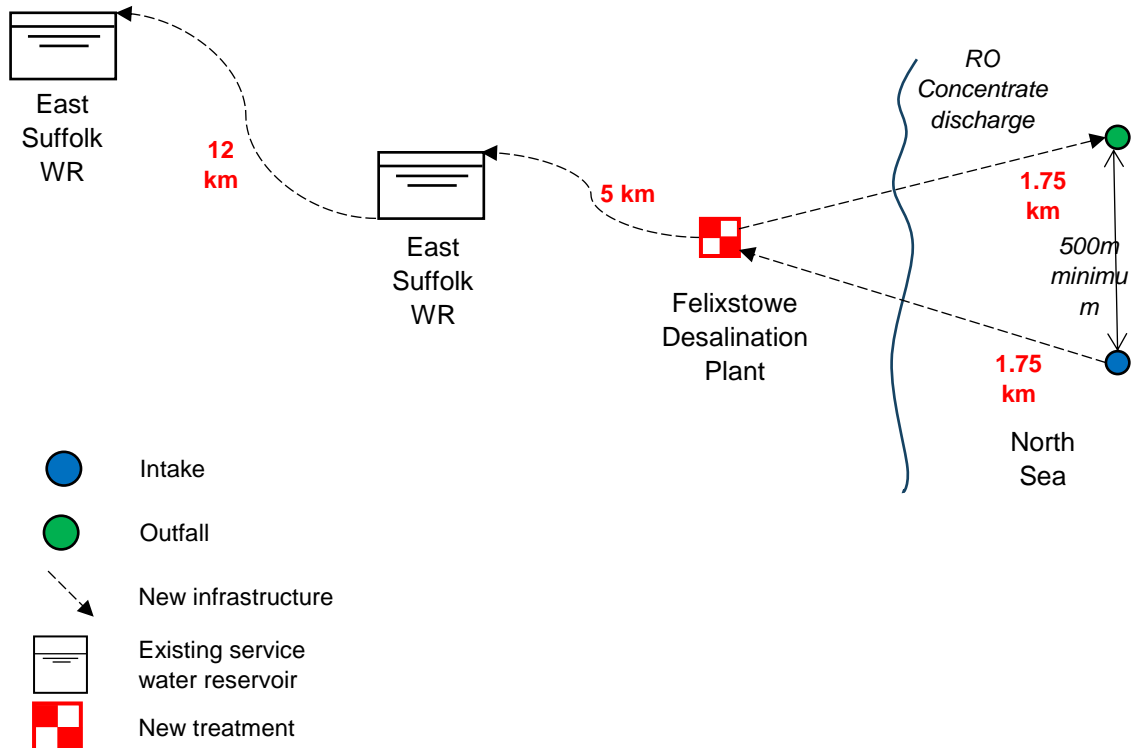
The seawater abstraction point and brine outfall point are located at a minimum of 500m apart and 250-500m from the shore.

Construction of the new Felixstowe Desalination Plant, including the intake and outfall pipelines and the transfer pipeline to Sprites Hall Water Reservoir (existing) and the transfer pipeline to Rushmere Water Reservoir (existing) are required for this option. The timescales for construction and commissioning of this option is two years (18 months construction / six months commissioning), therefore operation will begin after two years.

Capacity for this option is not limited by water availability from conventional sources. The size of the desalination plant is dictated on the supply-demand deficits and the cost-benefit analysis. The desalination plant has been designed for continuous operations with alternative operating regimes such as standby mode under normal operation and full capacity operation during summer or periods of drought

A schematic for this option is shown in Figure 2

Figure 2: Felixstowe Desalination option schematic



Source: Anglian Water (August 2018)

3.2 Designated Sites in the Zone of Influence

The proposed location of the Felixstowe desalination plant is near the port of Felixstowe on the east coast. The intake and outfall points will be within the North Sea, 250-500m from the shore and located at a minimum of 500m from each other.

The following European sites have been identified as occurring within the 5km Zol from this option:

- Stour and Orwell Estuaries SPA including marine component;
- Stour and Orwell Estuaries Ramsar site;
- Deben Estuary SPA including marine component;
- Deben Estuary Ramsar site;
- Thames Estuary SPA including marine component.

The option is shown in relation to these European sites in Appendix B.

The European sites are described in Sections 3.2.1 to 3.2.13. No European sites have been identified as occurring within a 500m Zol around the transfers associated with this option.

3.2.1 Stour and Orwell Estuaries SPA

The Stour and Orwell Estuaries SPA is in the eastern part of the Essex/Sussex border. It includes mud-flats, low cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. The site also includes some areas of low-lying grazing marsh. This SPA includes both marine areas and land not subject to tidal influences, with the marine part of the SPA termed a marine site¹⁶.

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

Table 5: Stour and Orwell Estuaries Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Hen Harrier <i>Circus cyaneus</i>		X	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Table 6: Stour and Orwell Estuaries migratory species of international importance (SPA)

Article 4.2 interest feature	Breeding	Over winter	Passage
Pintail <i>Anas acuta</i>		X	
Dunlin <i>Calidris alpina alpina</i>		X	
Black-tailed godwit <i>Limosa limosa islandica</i>		X	
Grey plover <i>Pluvialis squatarola</i>		X	
Redshank <i>Tringa tetanus</i>		X	
Ringed plover <i>Charadrius hiaticula</i>		X	
Shelduck <i>Tadorna tadorna</i>		X	
Turnstone <i>Arenaria interpres</i>		X	
Over winter, the area regularly supports 63,017 individual waterfowl (5-year peak mean 19/05/2005)	Cormorant, Pintail, Ringed Plover, Grey Plover, Dunlin, Black-tailed Godwit, Redshank, Shelduck, Great Crested Grebe, Curlew, Dark-bellied Brent Goose, Wigeon, Goldeneye, Oystercatcher, Lapwing, Knot, Turnstone.		

Sub-features (habitats) have also been identified within the European marine site in the Stour and Orwell Estuaries. The key sub-features are:

- Saltmarsh – used by golden plovers for roosting, particularly on the Stour Estuary. The saltmarshes of the Stour, grade from high marsh with species such as sea purslane *Atriplex portulacoides*, sea aster, *Aster tripolium*, and annual sea blite *Suaeda maritima* through to lower marsh dominated by glasswort *Salicornia sp* and cord grasses *Spartina spp*.
- Intertidal mudflat – the mudflats of the Stour Estuary are all rich in invertebrates, relatively undisturbed and are used by golden plovers for feeding.

3.2.2 Stour and Orwell Estuaries Ramsar site

The Stour and Orwell Estuaries comprises extensive mudflats, low cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. It provides habitats for an important assemblage of wetland birds in the non-breeding season and supports internationally important

¹⁶ English Nature (2001) Stour and Orwell Estuary European marine site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Issued 23 January 2001

numbers of wintering and passage wildfowl and waders. The site also holds several nationally scarce plants and British Red Data Book invertebrates.

Table 7: The Stour and Orwell Estuaries Ramsar Site¹⁷

Criterion	Qualifying Features of the Ramsar site	Notes
2	Supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	Contains seven nationally scarce plants: stiff saltmarsh-grass <i>Puccinellia rupestris</i> ; small cord-grass <i>Spartina maritima</i> ; perennial glasswort <i>Sarcocornia perennis</i> ; lax-flowered sea lavender <i>Limonium humile</i> ; and the eelgrasses <i>Zostera angustifolia</i> , <i>Z. marina</i> and <i>Z. nolt</i> Contains five British Red Data Book invertebrates: the muscid fly <i>Phaonia fusca</i> ; the horsefly <i>Haematopota grandis</i> ; two spiders, <i>Arctosa fulvilineata</i> and <i>Baryphema duffeyi</i> ; and the Endangered swollen spire snail <i>Mercuria confusa</i> .
5	Regularly supports 20,000 or more waterbirds	Species with peak counts in winter: 63017 waterfowl (5 year peak mean 1998/99-2002/2003)
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Species with peak counts in spring/autumn: common redshank Species with peak counts in winter: dark-bellied brent goose, northern pintail, grey plover, red knot, dunlin, black-tailed godwit, common redshank

3.2.3 Conservation objectives of the Stour and Orwell Estuaries¹⁸

The conservation objectives of the Stour and Orwell Estuaries are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

3.2.4 Vulnerability of the Stour and Orwell Estuaries

The Stour and Orwell Estuaries are subject to the impacts of erosion due to natural processes which are being exacerbated by fixed sea defences and port development. The key issues identified in the Site Improvement Plan for the SPA¹⁹ and the Ramsar Information Sheet are:

- Coastal squeeze causing loss and degradation of habitats due to the presence of coastal defences and sea level rise;
- Public access and disturbance from a range of land- and water-based activities causing disturbance impacts on waterbirds;
- Changes in species distribution shown by decreases in some of the species of birds present;
- Invasive species such as *Spartina anglica*, which may be impacting *Spartina maritima* and altering bird roosting and feeding areas of saltmarsh and mudflat;
- Numerous, small developments, development outside of the SPA and pressures to relax planning conditions on existing developments;

¹⁷ JNCC (2008). Ramsar Information Sheet: UK11067. Stour and Orwell Estuaries. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11067.pdf>

¹⁸ Natural England (2014). European Site Conservation Objectives for Stour and Orwell Estuaries Special Protection Area Site Code: UK9009121. Version 2, 30/062014. Available at: <http://publications.naturalengland.org.uk/publication/6069687402102784>

¹⁹ Natural England (2015). Site Improvement Plan – Stour and Orwell Estuaries. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

- Air pollution impacts, with the level of nitrogen deposition currently exceeding site-relevant critical loads;
- Freshwater habitat areas behind failing sea walls could be inundated by seawater;
- Pressures from commercial marine and estuarine fisheries.

3.2.5 Deben Estuary SPA and EMS

This site is located on the Suffolk coast and is a narrow, sheltered estuary with limited freshwater inputs, supporting nationally and internationally important flora and fauna. This SPA includes both marine areas and land not subject to tidal influences, with the marine part of the SPA, termed a marine site.

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive²⁰:

Table 8: Deben Estuary Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Pied avocet <i>recurvirostra avosetta</i>		X	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Table 9: Deben Estuary migratory species of international importance (SPA)

Article 4.2 interest feature	Breeding	Over winter	Passage
Dark-bellied brent goose		X	

Sub-features (habitats) have also been identified within the European marine site in Deben Estuary. The key sub-features are²¹:

- Intertidal mudflat communities – support populations of invertebrates which are an important food source for avocet as well as plants and green algae which dark-bellied brent geese feed on;
- Saltmarsh communities – important habitat for roosting avocet and provide food sources for wintering dark-bellied brent geese.

3.2.6 Deben Estuary Ramsar site

Deben Estuary is designated as a Ramsar site for the following features:

Table 10: Deben Estuary Ramsar Site²²

Criterion	Qualifying Features of the Ramsar site	Notes
2	Supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	Supports a population of the mollusc <i>Vertigo angustior</i> (Habitats Directive Annex II (S1014); British Red Data Book Endangered). Martlesham Creek is one of only about fourteen sites in Britain where this species survives

²⁰ JNCC (2006). Site Code: UK9009261 Deben Estuary SPA citation. UK9009261 Compilation date: May 2006 Version: 1.1 Classification citation

²¹ English Nature (2001) Hamford Water. European Marine Site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

²² JNCC (2008). Ramsar Information Sheet: UK11028. Hamford water. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11028.pdf>

Criterion	Qualifying Features of the Ramsar site	Notes
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Species with peak counts in winter: Dark-bellied brent goose

3.2.7 Conservation Objectives of Deben Estuary²³

The conservation objective for Deben Estuary SPA is to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The population of each of the qualifying features;
- The distribution of the qualifying features within the site.

3.2.8 Vulnerability of Deben Estuary

The main pressure on the site is posed by sea level rise and coastal squeeze. The key issues identified in the Site Improvement Plan for the SPA²⁴ and the Ramsar Information Sheet are:

- Coastal squeeze threatening quality and area of saltmarsh habitats used by SPA birds for feeding, roosting and/or nesting;
- Changes in species distributions with *Spartina anglica* encroaching at the front of estuarine muds and reeds encroaching from the back;
- Public access and disturbance caused by recreational activity including boats, dog walkers and low flying aircraft;
- Air pollution impacts, with nitrogen deposition exceeding the site-relevant critical load for ecosystem protection;
- Pressures from commercial and estuarine fisheries;
- Potential water quality problems; eutrophication may be having an influence on reed growth and saltmarsh composition.

3.2.9 Outer Thames Estuary SPA

The Outer Thames Estuary SPA is a European marine site which lies along the east coast of England in the southern North Sea, extending northward from the Thames Estuary to the sea area off Great Yarmouth on the East Norfolk Coast. It covers an area of c. 3,924km², classified for the protection of wintering red-throated diver, with the area supporting the largest aggregate of the species in the UK.

This site supports the following species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC²⁵:

²³ Natural England (2014). European Site Conservation Objectives for Deben Estuary Special Protection Area Site Code: UK9009261. Version 2, 30/062014. Available at: <http://publications.naturalengland.org.uk/publication/5749484436848640>

²⁴ Natural England (2015). Site Improvement Plan – Hamford Water. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

²⁵ JNCC (2011). Site Code: UK9020309 Outer Thames Estuary citation. UK9020309 Compilation date: November 2017 (latest update)

Table 11: Thames Estuary Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Red-throated diver <i>Gavia stellata</i>		X	
Common tern <i>Sterna hirundo</i>	X		
Little tern <i>Sternula albifrons</i>	X		

3.2.10 Conservation Objectives of Thames Estuary²⁶

The conservation objectives for the Outer Thames Estuary SPA are, subject to natural change, to maintain or enhance the red-throated diver population (*Gavia stellata*) and its supporting habitats in favourable condition. Further detail on these objectives and actions to support it are detailed in the Outer Thames Estuary SPA Conservation Objectives and Advice on Operations document²⁷. This includes managing human activities such that they do not result in deterioration or disturbance, or impede the restoration of the red-throated diver through any of the following:

- Physical loss of habitat by removal (e.g. capital dredging, harvesting, coastal and marine development)
- Physical damage by physical disturbance or abrasion of habitat (e.g. extraction)
- Non-physical disturbance through noise or visual disturbance (e.g. shipping, wind turbines)
- Toxic contamination by introduction of synthetic and/or non-synthetic compounds (e.g. polychlorinated biphenyls (PCBs), pollution from oil and gas industry, shipping)
- Non-toxic contamination to prey species only by changes in e.g. turbidity (e.g. capital and maintenance dredging)
- Biological disturbance by selective extraction of species (e.g. commercial fisheries) and non-selective extraction (eg entanglement with netting and wind turbine strike)

3.2.11 Vulnerability of Outer Thames Estuary

There is a working assumption that the current condition of the features for which this SPA is designated are in favourable condition. However, understanding the functioning of large, varied, dynamic marine and estuarine sites is complex and difficult. The primary issue identified in the SPA's Site Improvement Plan²⁸ is ongoing pressure from commercial fisheries. This has been assessed as having the following potential effects:

- Fishing gear methods such as set gillnets and drift netting represent potentially the most serious direct risk from fishing activity to the birds themselves, with entanglement in fishing nets being an important cause of death for red-throated divers in the UK waters;
- Disturbance and displacement effects may arise from boat movements associated with fishing activities;
- Removal of fish and larger molluscs can have a significant impact on the structure and functioning of benthic communities.

²⁶ Natural England (2017). European Site Conservation Objectives for Outer Thames Estuary Special Protection Area Site Code: UK9020309. Version 2, 20/12/2017. Available at: <http://publications.naturalengland.org.uk/publication/4927106139029504>

²⁷ JNCC and Natural England (2014). Outer Thames Estuary Special Protection Area. Draft advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended) and Regulation 18 of The Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended). Version 3.7 March 2013.

²⁸ Natural England (2015). Site Improvement Plan – UK9020309 Outer Thames Estuary. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

3.2.12 Qualifying habitats of the Stour and Orwell Estuaries SPA/Ramsar, Deben Estuary SPA/Ramsar and Outer Thames Estuary SPA within the Zone of Influence

The condition assessments for the Orwell Estuary SSSI²⁹, Stour Estuary SSSI and Deben Estuary SSSI provide an indication of the baseline condition of these sites.

There are 23 units within the Orwell Estuary SSSI, three of which lie within the 5km ZoI of this option (Units 15, 16 and 23), approximately 4km north west of the proposed desalination plant. Unit 23, known as Trimley Marshes, contains a mosaic of open water and reedbed with an extensive area of grazing marsh. It was assessed as being in Favourable condition in 2010 with two pairs of avocet seen as well as marsh harrier, shelduck, mute swan, gadwall, little grebe, shoveler, pintail, redshank, reed bunting, Cetti's warbler, sedge warbler, and reed warbler. Units 15 and 16 are areas of littoral sediment on the west and east bank of the estuary, respectively. They were both assessed as being in Unfavourable condition in 2009, with Unit 15 impacted by dredging and enclosure by a sea wall causing coastal squeeze and loss of its salt marsh habitat. Unit 16 is a stretch of estuary with avocets, little egrets and godwits observed using the tidal mud during the survey. Several rare plant species were also observed: the nationally scarce shrubby sea-blite *Suaeda vera* and golden samphire *Inula crithmoides*; and the vulnerable prickly saltwort *Salsola kali*. No significant transitions between salt marsh zones were observed and the natural development of the saltmarsh is constrained by the sea wall.

Within the Stour Estuary SSSI, Unit 9 lies in the ZoI approximately 4.7km south west of the proposed desalination plant and was assessed as being in Favourable condition in 2010. This is an area of littoral sediment and all the bird interest features for this unit: dark-bellied brent geese; dunlin; knot; ringed plover; grey plover; redshank; and shelduck have populations on the site that are above their conservation objectives threshold.

Units 19, 20, 21, and 22 of the Deben Estuary SSSI are within the option's ZoI approximately 3.9km north west of the proposed site and were all assessed as being in Unfavourable – Declining in 2011, particularly due to the impacts of coastal squeeze. These are primarily areas of saltmarsh, each affected to varying degrees by the impacts of coastal squeeze, erosion and in some cases disturbance.

Based on the habitat descriptions included in the condition assessments summarised above, it is considered that the features which meet Ramsar Criterion 2 for the Stour and Orwell Estuaries Ramsar site, and the sub-features listed for the Stour and Orwell Estuaries and Deben Estuary EMS, are present within the ZoI (saltmarsh and intertidal mud flats).

A very small area of the Outer Thames Estuary SPA (c.0.3km²) overlaps with the 5km ZoI around the proposed desalination plant. This represents less than 0.001% of the site's total area and is over 4km away from the proposed option. The qualifying features of this SPA have therefore been screened out of this assessment. It is considered that the proposed Felixstowe desalination option would have no significant impact on the integrity of this site or undermine its conservation objectives in relation to the red-throated diver, with the Outer Thames Estuary SPA therefore not further considered in this appropriate assessment.

3.2.13 Qualifying birds of the Stour and Orwell Estuaries SPA/Ramsar and Deben Estuary SPA/Ramsar within the Zone of Influence

All the qualifying bird species of Stour and Orwell Estuaries SPA and Ramsar sites and Deben Estuary SPA and Ramsar sites have either been recorded during condition assessment surveys

²⁹ Condition assessment for the Humber Estuary SSSI available at:
<https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S1002511&ReportTitle=Orwell%20Estuary%20SSSI>

or have the potential to be supported by the habitats present. All the following species are therefore screened in to this appropriate assessment:

- Pied avocet
- Pintail
- Dark-bellied brent goose
- Dunlin
- Knot
- Black-tailed godwit
- Grey plover
- Redshank
- Pintail
- Ringed plover
- Shelduck
- Turnstone

3.3 Potential Impacts of ESU1 Felixstowe Desalination

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UK WIP guidance (Table 2). The proposed location of the desalination plant, intake and outfall points and all associated pipelines are at a distance far enough beyond the boundaries of the European site (at least 3.9 km), that no impacts from disturbance (noise/visual/light) or physical damage (habitat loss or degradation) through construction are anticipated.

There is uncertainty with regards to whether the infrastructure related to the implementation of the Plan would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size and scale of the proposed Felixstowe desalination option, the impacts with the potential to result in adverse effects are:

Construction Impacts

- Toxic contamination
 - Water pollution;
 - Air pollution.

Operational Impacts

- Physical damage
 - Habitat degradation.
- Water table / availability
 - Changes to surface water levels and flows.
- Non-toxic contamination
 - Changes in salinity.
- Biological disturbances
 - Changes to habitat availability.

3.3.1 Construction Impacts

3.3.1.1 Toxic Contamination

Water Pollution

During the construction period, materials and machinery are likely to be mobilised in the North Sea for the construction of the proposed intake and outfall pipelines. If a water pollution incident should occur, a pathway exists to impact the European sites through diffusion into the estuaries. This may cause adverse effects on the qualifying habitat features, with potential knock-on impacts on the qualifying bird species. Water quality has already been identified as a pressure in the Deben Estuary SPA and Ramsar sites, with any pollution impacts from the proposed scheme therefore having the potential to exacerbate this.

It is possible that impacts on water pollution could have an indirect, knock-on effect on the physical habitat of the European sites, resulting in habitat degradation, which could in turn impact habitat availability and thus impact biological communities within the sites.

Air Pollution

Air pollution can result from the release of particulate matter (dust) into the atmosphere or through exhaust emissions from vehicles. Developments associated with the scheme are likely to involve dust generating activities during the construction phase of the desalination plant and associated pipelines, thereby increasing air pollution in the area. While the distance at which significant effects are likely to occur is dependent on the extent and nature of mitigation measures, prevailing wind direction, and rainfall, effects from construction activities that generate dust are generally limited to within 150-200m³⁰.

The distance of the proposed desalination plant from the European sites (>4km), means that air pollution impacts from dust are not anticipated to result in significant adverse impacts on the qualifying species of the European sites. This effect is therefore scoped out from further assessment.

Toxic contamination: adverse effects on European sites

The interest features of the European sites which may experience adverse effects through water pollution are:

- Stour and Orwell Estuaries SPA
 - Breeding and overwintering bird populations of European importance: these species use intertidal and estuarine habitat for breeding feeding or loafing – these habitats are sensitive to pollution impacts.
- Stour and Orwell Estuaries Ramsar site
 - Ramsar Criterion 2 (saltmarsh species and aquatic invertebrates are sensitive to pollution impacts, which may cause changes in species composition);
 - Ramsar Criterion 5 (the supporting habitat of waterbirds is sensitive to pollution impacts);
 - Ramsar Criterion 6 (the supporting habitat of waterbirds is sensitive to pollution impacts).
- Deben Estuary SPA
 - Overwintering bird populations of European importance: these species use mudflat and saltmarsh habitat for feeding or loafing – these habitats are sensitive to pollution impacts with water pollution already listed as a threat to Deben Estuary.

³⁰ Highways Agency 2007, Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, HA207/07 (Air Quality). Available at: <<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20707.pdf>> [Accessed 22 November 2017].

- Deben Estuary Ramsar site
 - Ramsar Criterion 2: the supporting habitat of *Vertigo angustior* (marshy ground) may be altered by pollution impacts and direct mortality of populations of the species may be caused through ingestion of polluted water and food sources;
 - Ramsar Criterion 6: the dark-bellied brent goose relies on estuarine habitat and intertidal plants for feeding; these are sensitive to water pollution, which is already listed as a threat to Deben Estuary.

3.3.2 Operation Impacts

3.3.2.1 Water table / availability

Changes to surface water levels and flows

This option includes a new intake and outfall point within the North Sea, outside the boundary of all European sites. Increased abstraction has the potential to impact the qualifying features of the European sites should changes in water availability and flows occur within the European sites. However, considering the distance of the intake and outfall points from the European sites (>4km); the natural fluctuation in water levels of these intertidal sites; and the likelihood that overall flows will be balanced between intake and outfall, it is considered that this effect will not result in a significant adverse impact on the qualifying species of the European sites.

Water table / availability: adverse effects on European sites

Given the tidal nature of the estuary sites, freshwater input is only a minor contributor to levels and flows in the estuaries. Consequently, no significant adverse effects from changes to surface water levels and flows are foreseeable on any of the qualifying features of the European sites.

3.3.2.2 Non-toxic contamination

Changes in salinity

The proposed Felixstowe Desalination option includes an outfall point within the North Sea for the discharge of brine produced through the reverse osmosis process used in desalination. Depending on the concentration and volume to be discharged, brine may affect the salinity and temperature of water. While there is uncertainty surrounding the long-term impacts of this on the marine habitat, certain habitat groups and species may be impacted by these changes. Stour, Orwell and Deben estuaries are hydrologically linked to the outfall point with a potential pathway for impact therefore existing. Salinity is an essential functional component of estuaries, with the salinity gradient determining the species which live along it. However, the boundary of the sites is approximately 4km or further from the proposed outfall, with changes in salinity or temperature likely to be significantly decreased at these points. In the absence of detailed modelling results, this effect is precautionarily scoped in for assessment.

Non-toxic contamination: adverse effects on European sites

The interest features of the European sites which may experience adverse effects through non-toxic contamination are:

- Stour and Orwell Estuaries Ramsar
 - Ramsar Criterion 2 (saltmarsh species associated with estuarine habitats have the potential to be impacted by changes in salinity levels).
- Deben Estuary Ramsar
 - Ramsar Criterion 2: vegetation associated with estuarine habitats has the potential to be impacted by changes in salinity levels, altering the supporting habitat of *Vertigo angustior*.

3.4 Summary of Potential Impacts of the Option

The assessment of potential impacts of the Felixstowe Desalination option given in Section 3.3 has identified the potential impacts that are considered likely to result in adverse effects on the conservation objectives and qualifying features of European sites. These are summarised in the table below:

Table 12: Summary of potential adverse effects of Felixstowe Desalination option on European sites

European Site	Potential Adverse Impact	Sensitive Interest Feature	Permanent or Temporary
Stour and Orwell Estuaries SPA	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Breeding and overwintering birds Congregatory waterfowl	Temporary during construction only
Stour and Orwell Estuaries Ramsar	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Criterion 2 (saltmarsh plant species and invertebrate species) Criterion 5 (congregatory waterfowl) Criterion 6 (breeding and overwintering birds)	Temporary during construction only
	Non-toxic contamination (specifically changes in salinity and temperature) due to discharge of brine at outfall point	Criterion 2 (saltmarsh plant species)	Permanent during periods of operation of the desalination plant
Deben Estuary SPA	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Overwintering birds	Temporary during construction only
Deben Estuary Ramsar	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Criterion 2 (invertebrate species) Criterion 6 (overwintering birds)	Temporary during construction only

3.5 Conclusions and Recommendations

3.5.1 Background

ESU1 is a seawater desalination option situated within the area of the Port of Felixstowe in Suffolk. It involves the construction of a new desalination plant, inflow and outflow pipes and a new connecting pipeline. Construction is anticipated to take 18 months. During operation, water will be extracted from the North Sea via an intake pipeline (250-500m offshore) to the new desalination plant. After the desalination process which also includes water treatment, the water will be pumped approximately 5km via a new transfer pipeline to the existing Sprites Hall water reservoir. The water will then be transferred to the existing Rushmere water reservoir by a new 12km transfer pipeline and will then be immediately available for distribution in the potable network. The brine outfall from the Felixstowe Desalination Plant will be returned to the North Sea via an outfall pipe.

3.5.2 Summary of Potential Effects on European Sites

A HRA Task II: Appropriate Assessment considered the impact of a plan on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its structure and function. The Task II assessment can be addressed in answer to the following questions:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed option is not within the boundary of a European site

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as being in hydrological continuity with the proposed WRMP option:

- Stour and Orwell Estuaries SPA and EMS;
- Stour and Orwell Estuaries Ramsar site;
- Deben Estuary SPA and EMS;
- Deben Estuary Ramsar site;
- Outer Thames Estuary SPA.

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s) identified, either directly or indirectly?

It has been identified that there is a likelihood for adverse effects on the Stour and Orwell Estuaries SPA/Ramsar site and Deben Estuary SPA/Ramsar site during construction and operation of the option. Temporary construction impacts relate to pollution events resulting in adverse effects on water quality and operation impacts may cause non-toxic contamination due to changes in salinity as a result of discharged brine.

3.5.3 Proposed Mitigation Measures

Specific mitigation will be devised at project level, when the option is likely to be subject to an appropriate ecological impact assessment and project-level HRA, informed by survey and applicable to finalised detailed design. For the identified construction effects, the following mitigation measures are considered appropriate however and it is considered, on the basis of the available information, that the option is unlikely to result in adverse effects on the integrity of the European sites or their interest features when the following mitigation is employed:

- Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW).³¹

For impacts identified during operation of the option which relate to the discharge of brine, the extent to which the qualifying features of the European sites are affected cannot be determined at this stage. Further investigation and detail as to the volume and concentration of brine released will be required, which will potentially be supported by a field study and design-specific impact assessment. Anglian Water is committed to mitigation, and it is assumed that after further investigation at the project-level HRA, and with the application of mitigation such as is

³¹ GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in GPP 5: Works and maintenance in or near water (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

proposed below, that the option will only be implemented with the assurance that no residual effects are likely.

- Potential mitigation strategy for changes to salinity:
 - The significance of change to salinity levels will depend on the concentration and volume of brine discharge at the proposed outfall point. Determining a set target for salinity is complex due to the dynamic nature of the marine environment. However, as per guidance on Common Standards Monitoring Guidance for Estuaries³², readings should not deviate from the salinity range predicted for the site by the baseline data. Following these guidelines and suggested techniques should mitigate the risk of significant adverse effects from changes in salinity levels on the qualifying features of the European sites.

3.5.4 Summary of HRA Task II: Appropriate Assessment

For the impacts identified during operation (i.e. potential increased salinity as a result of brine discharge), the effects of this impact will need to be explored further in order to demonstrate that the integrity of European sites will not be significantly adversely affected. It is assumed however that appropriate measures can be put in place to ensure there is no residual effects on the integrity of the European sites. No significant adverse effects are reasonably foreseeable on the integrity of European sites as a result of construction when appropriate mitigation measures are employed.

The overall likelihood of adverse impacts of the Felixstowe desalination option on the qualifying features are summarised in Table 13.

Table 13: Assessment of potential adverse impacts of Felixstowe Desalination on the European qualifying features within the ZoI (✓ = adverse impact cannot be excluded; X = adverse impact can be excluded; X^m= adverse impact can be excluded following defined mitigation measures; X^p=adverse impact likely to be excluded following further investigation at project-level)

Qualifying feature	European sites	Potential impacts of ESU1 Felixstowe Desalination							
		Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and flows	Change in salinity	Changes to habitat availability
Pied avocet	Stour and Orwell Estuaries SPA Deben Estuary SPA	X	X	X	X ^m	X	X	X ^p	X
Pintail	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Dark-bellied brent goose	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar Deben Estuary SPA	X	X	X	X ^m	X	X	X ^p	X

³² JNCC (2004). Common Standards Monitoring Guidance for Estuaries

Potential impacts of ESU1 Felixstowe Desalination

Qualifying feature	European sites	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and flows	Change in salinity	Changes to habitat availability
	Debden Estuary Ramsar								
Dunlin	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Knot	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Black-tailed godwit	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Grey plover	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Redshank	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Pintail	Stour and Orwell Estuaries SPA	X	X	X	X ^m	X	X	X ^p	X
Ringed plover	Stour and Orwell Estuaries SPA	X	X	X	X ^m	X	X	X ^p	X
Shelduck	Stour and Orwell Estuaries SPA	X	X	X	X ^m	X	X	X ^p	X
Turnstone	Stour and Orwell Estuaries SPA	X	X	X	X ^m	X	X	X ^p	X
Waterbird assemblage	Stour and Orwell Estuaries SPA	X	X	X	X ^m	X	X	X ^p	X
Nationally scarce plants (Ramsar Criterion 2)	Stour and Orwell Estuaries Ramsar	X	X	X	X ^m	X	X	X ^p	X
Invertebrate species of the British Red Data Book (Ramsar Criterion 2)	Stour and Orwell Estuaries Ramsar Debden Estuary Ramsar	X	X	X	X ^m	X	X	X ^p	X

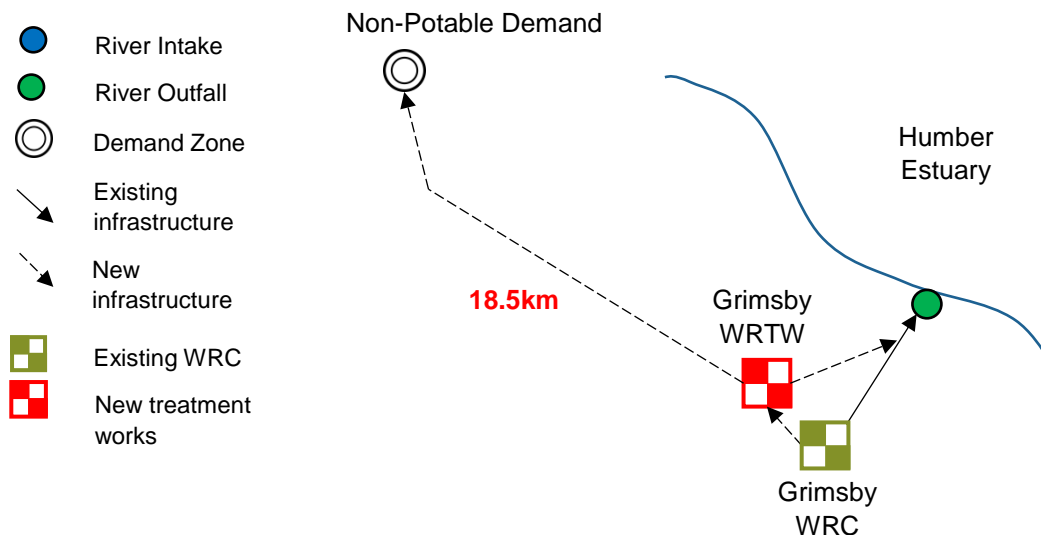
4 SHB2 - Pyewipe Water Reuse for Non-Potable Use

4.1 Option Description

This option proposes to transfer non-potable water from Pyewipe Water Recycling Centre (WRC) located in Grimsby Port, to the new Pyewipe Water Reuse Treatment Works (WRTW) through a new pipeline (see Figure 3). This pipeline route is unknown and has been assumed to be a straight line linking the assets, it is unlikely to be a significant length. The water is then treated at the new WRTW to be located in the Pyewipe industrial estate; and then transferred to the demand hub (Immingham demand hub) ready to be used via a new 19km pipeline. This would be a non-potable reuse. The remainder of the treated effluent water is pumped out into the Humber estuary via an outflow pipeline located downstream at Grimsby Port, this pipeline has also been assumed to be a straight line. This option aims to reduce the non-potable abstraction on the Witham to supply industry on the Humber bank, and/or free up Trent Witham Ancholme (TWA) scheme water at Elsham for potable supply, which may be limited by the need to supply non-potable works.

The construction and commissioning phase of the option will last two years (18 months' construction/six months commissioning) the equivalent of the short-term significance of the effect.

Figure 3: Pyewipe Option Schematic



Source: Anglian Water (August 2018)

4.2 Designated Sites in the Zone of Influence

The Task I: Screening assessment identified three European sites where this option has the potential to result in adverse effects. These are:

- The Humber Estuary Special Protection Area (SPA)
- The Humber Estuary Ramsar site
- The Humber Estuary Special Area of Conservation (SAC)

The location of the proposed Pyewipe WRTW and the existing Pyewipe WTW/WRC is on the south bank of the Humber Estuary in the Grimsby port area, within 100m of the boundary of the SPA/Ramsar site/SAC. The transfer pipeline from the WRTW to Immingham will be closest to the estuary at the Pyewipe end and routed further inland and considerably distant from it as it proceeds towards Immingham. Therefore, the Zone of Influence (Zoi) of the transfer pipeline does not include the Humber Estuary in locations outside the Grimsby port area. The existing outfall is located on the banks of the Humber at the port area.

The designated sites are described in Section 4.2.1 below, along with their qualifying features, conservation objectives and vulnerabilities. The option is shown in relation to these European sites in Appendix B.

4.2.1 The Humber Estuary

The Humber Estuary is a macro-tidal, coastal-plain estuary which drains a catchment of over 24,000 square kilometres. It has the second-highest tidal range in Britain (max 7.4m) and approximately one-third of the estuary is exposed as mud or sand flats at low tide. The inner estuary supports extensive areas of reedbed, with areas of mature and developing saltmarsh backed by grazing marsh in the middle and outer estuary. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them.

4.2.2 The Humber Estuary SPA

This site qualifies as an SPA under Article 4.1 of the Directive (79/409/EEC) by supporting breeding, over-wintering, and passage populations of European importance of the following species listed on Annex I of the Directive³³. These are summarised in Table 14.

Table 14: Humber Estuary Annex I species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Bittern <i>Botaurus stellaris</i>	x	x	
Marsh harrier <i>Circus aeruginosus</i>	x		
Hen harrier <i>Circus cyaneus</i>		x	
Avocet <i>Recurvirostra avosetta</i>	x	x	
Golden plover <i>Pluvialis apricaria</i>		x	
Bar-tailed godwit <i>Limosa lapponica</i>		x	
Little tern <i>Sternula albifrons</i>	x		
Ruff <i>Philomachus pugnax</i>			x

³³ JNCC (2001). Site Code: UK9006111 Humber Estuary SPA citation. UK9006111 Compilation date: July 2007 Version: 2.0 Classification citation

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species not listed in Annex I and internationally important numbers of wildfowl and waders:

Table 15: The Humber Estuary migratory species of international importance (SPA)

Article 4.2 Interest Feature	Breeding	Over winter	Passage
Shelduck <i>Tadorna tadorna</i>		x	
Knot <i>Calidris canutus</i>		x	
Dunlin <i>Calidris alpina</i>		x	
Black-tailed godwit <i>Limosa limosa</i>		x	x
Redshank <i>Tringa totanus</i>		x	x
Over winter, the area regularly supports 187,617 individual waterfowl (5-year peak mean 1991/2 - 1995/6)	Teal, wigeon, mallard, turnstone, pochard, scaup, bittern, dark-bellied brent goose, goldeneye, sanderling, dunlin (ssp. <i>alpina</i>), knot, ringed plover, oystercatcher, bar-tailed godwit, black-tailed godwit (ssp. <i>islandica</i>), curlew, whimbrel, ruff, golden plover, grey plover, avocet, shelduck, greenshank, redshank, lapwing		

4.2.3 Humber Estuary Ramsar site

The Humber Estuary qualifies for inclusion as a Ramsar site under five criteria of the Ramsar Convention on Wetlands of International Importance³⁴, as summarised in Table 16.

Table 16: The Humber Estuary Ramsar site

Criterion	Qualifying features of the Ramsar site	Notes
1	It contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region	Includes the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.
3	It supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region	Supports a breeding colony of grey seals at Donna Nook. The dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad <i>Epidalea calamita</i>
5	It regularly supports 20,000 or more waterbirds	153,934, non-breeding season (peak mean 1998/99-2002/2003)
6	It regularly supports 1% of the individuals in a population of one species or subspecies of waterbird	Spring/Autumn: golden plover <i>Pluvialis apricaria</i> , red knot <i>Calidris canutus</i> , dunlin <i>Calidris alpina</i> , black-tailed godwit <i>Limosa limosa</i> , common redshank <i>Tringa totanus</i> . Winter: shelduck <i>Tadorna tadorna</i> , golden plover <i>Pluvialis apricaria</i> , red knot <i>Calidris canutus</i> , dunlin <i>Calidris alpina</i> , black-tailed godwit <i>Limosa limosa</i> , bar-tailed godwit <i>Limosa lapponica</i> , redshank <i>Tringa totanus</i>
8	The Humber Estuary acts as an important migration route	Important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas

4.2.4 The Humber Estuary SAC

The Humber Estuary is designated as a SAC under article 4(4) of the Directive (92/43/EEC). The site includes tidal rivers, estuaries, mud and sand flats, lagoons, salt marshes, coastal sand

³⁴ JNCC (2007). Ramsar Information Sheet: UK11031. Humber Estuary. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11031.pdf>.

dunes and beaches and bogs, marshes and fens. The primary qualifying features (Annex 1 habitat types) of the Humber Estuary SAC are presented in Table 17.

Table 17: The Humber Estuary SAC

Qualifying feature	Description
Annex I Habitat	
Estuaries	This site is the second-largest coastal plain estuary in the UK and the largest on the east coast of Britain. It is a muddy, macro-tidal estuary, fed by the Rivers Ouse, Trent and Hull, Ancholme and Graveney. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast. This is the northernmost of the English east coast estuaries whose structure and function is intimately linked with soft eroding shorelines. As salinity declines upstream, reedbeds and brackish saltmarsh communities fringe the estuary. Upstream of the Humber Bridge is also noteworthy for extensive mud and sand bars, which in places form semi-permanent islands.
Mudflats/ sandflats	The Humber Estuary includes extensive intertidal mudflats and sandflats not covered by seawater at low tide. Upstream from the Humber Bridge, extensive mud and sand bars in places form semi-permanent islands.

Habitats/ species present as a qualifying feature of the SAC, but not a primary reason for selection have also been identified within the European site. These features are:

- Sandbanks which are slightly covered by sea water all the time
- Coastal lagoons
- *Salicornia* and other annuals colonising the mud and sand
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Embryonic shifting dunes
- Shifting dunes along the shoreline with *Ammophila arenaria*
- Fixed coastal dunes with herbaceous vegetation
- Dunes with *Hippopha rhamnoides*
- Sea lamprey *Petromyzon marinus*
- River lamprey *Lampetra fluviatilis*
- Grey seal *Halichoerus grypus*

4.2.5 Conservation Objectives of the Humber Estuary³⁵

The conservation objectives of The Humber Estuary SPA are to ensure that the site contributes to achieving the aims of the Wild Birds Directive. The conservation objectives of the Humber Estuary SAC³⁶ are to ensure that the integrity of the site is maintained or restored as appropriate and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features. The Humber Estuary SPA, SAC and Ramsar site overlap, so the conservation objectives for the Ramsar site are considered the same as for the SPA/SAC.

These objectives will be met by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features

³⁵ Natural England (2014). European Site Conservation Objectives for Humber Estuary Special Protection Area Site Code: UK9006111. Publication date: 30 June 2014 (Version 3). This document updates and replaces an earlier version dated 31 March 2014. Previous references to additional features identified in the 2001 UK SPA Review have been removed.

³⁶ Natural England (2014). European Site Conservation Objectives for Humber Estuary Special Area of Conservation Site Code: UK0030170. Publication date: 31 March 2014 – version 2. This document updates and replaces an earlier version dated 29 May 2012 to reflect Natural England's Strategic Standard on European Site Conservation Objectives 2014.

- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

4.2.6 Vulnerabilities of the Humber Estuary

The Humber Estuary is subject to the impacts of human activities (past and present) as well as on-going processes such as sea level rise and climate change. The key issues identified in the Site Improvement Plan (SIP) for the SPA/SAC³⁷ and the Ramsar Information Sheet are:

- Water pollution from domestic sewage such as dissolved oxygen sag and mineral leaching from former industry and clay abstraction.
- Coastal squeeze resulting in a loss of saltmarsh and mudflat habitats.
- Changes in species distribution.
- Undergrazing affecting the maintenance of roosting/loafing habitat for birds and inappropriate scrub management in some areas.
- The presence of invasive species such as water fern, Himalayan balsam, giant hogweed and Japanese knotweed. Marine invasive species are also present with the slipper limpet and Chinese mitten crab being an issue, however the extent is unknown.
- Natural changes in site condition including increased sediment load resulting in reduction of important habitats birds.
- Public access/recreational disturbance which could be contributing to the declines in breeding and migratory bird populations at certain locations (particularly illegal access by motorised recreational vehicles).
- Pressure from inland fisheries and stocking of non-native fish species in coastal claypits.
- Pressures from marine and commercial overfishing which includes use of dredges (including hydraulic), benthic trawls and seines.
- Direct land take from development including sea defences.
- Air Pollution and the impact of atmospheric nitrogen deposition.
- Shooting/scaring including bird management in some areas.
- Direct impact from third party practices, including commercial scale collection of *Salicornia*.
- Inappropriate scrub control resulting in encroachment on grassland and reedbeds.

4.2.7 Qualifying habitats of the Humber Estuary within the Zone of Influence

The condition assessment for the Humber Estuary SSSI³⁸ provides an indication of the baseline conditions for this assessment, in terms of the likely presence or absence of the qualifying features of the European sites within the Zol. The habitats within the Zol of the works at this location correspond to the Humber Estuary SSSI units 86, 84 and 85, i.e. fen/marsh and swamp and littoral sediment³⁹.

The Zol from the outfall is considered to be 5km from source, which includes Units 87, 88, 89, 173, 174, 175 and 185. These units comprise littoral sediment – i.e. sedimentary habitats

³⁷ Natural England (2015). Site Improvement Plan – Humber Estuary. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future. Available at: <http://publications.naturalengland.org.uk/publication/5427891407945728>

³⁸ Condition Assessment for Humber Estuary available at <https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S1000503&ReportTitle=Ouse+WashesSSSI>

³⁹ From Natural England - the Humber Estuary Site of Special Scientific Interest (SSSI) unit condition assessment report. Available at <https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S2000480&ReportTitle=Humber%20Estuary%20-%202000480%20SSSI>

located between high and low water including shingle, gravel, sand and mud habitats, or a combination of these, which occur in the intertidal zone. These are broadly classified as intertidal mudflat/saltmarsh and are estuarine habitats, confirming the presence of habitat qualifying under Criterion 1 of the Humber Estuary Ramsar site and a primary reason for selection of the Humber Estuary SAC (1130 Estuaries).

The Humber High Tide Roost Review⁴⁰ also provides an indication of the habitat in the area. The Middle Humber, within which this option is located, is described as featuring a wide intertidal area on the north bank (c. 1km width), which is reduced to a few hundred meters wide on the south bank. Land use of the south bank varies greatly from agricultural, to industrial areas (as per the location of the bulk of this option) and port complexes.

4.2.8 Qualifying bird species of the Humber Estuary within the Zone of Influence

Although considered in unfavourable – recovering condition, the habitats present in the ZoI have the potential to support waterfowl species of European importance listed as qualifying features of the SPA/Ramsar site (wildfowl and wading; breeding and migratory).

The following qualifying bird features of the European sites have been screened out from this assessment:

- Bittern (breeding and overwinter) – no suitable habitat (clay pits and extensive reedbeds) present in the ZoI, with the closest site known to support a male bittern (Far Ings), approximately 20km away⁴¹.
- Marsh harrier (breeding) – no suitable nesting habitat (open freshwater wetlands with dense, tall vegetation) present in the ZoI.
- Hen harrier (overwinter) – not recorded in the ZoI, with closest known overwinter habitat (Blacktoft Sands Nature Reserve) over 40km away⁴².

The remaining qualifying bird features cannot be confidently excluded from the ZoI as their supporting habitat (as summarised in Appendix B) is present within the area. Therefore, applying the precautionary principle, they are included in this assessment:

- Avocet (breeding and overwinter) – breeds in flat open areas on shallow saline or brackish wetlands with ground for feeding/roosting.
- Little tern (breeding) – breeds on habitats including estuaries and saltmarshes.
- Bar-tailed godwit (overwinter) – during winter it is common in intertidal areas along muddy coastlines and estuaries.
- Golden plover (overwinter) – winter habitat includes agricultural land, with foraging in intertidal flats and saltmarshes.
- Ruff (passage) – habitat occupied in the non-breeding season includes rivers and marshes
- Shelduck (overwinter) – frequents mudflats and muddy or sandy estuaries.
- Knot (overwinter and passage) – outside the breeding season, frequents tidal mudflats or sandflats.

⁴⁰ Cutts, N. and Hemingway, K. (2016). Humber Estuary High Tide Roost Review 2013-2014. Available at: <http://humburnature.co.uk/admin/resources/final-htrr-report-2013-14.pdf>

⁴¹ Humber Nature Partnership (2016). Available at: <http://jncc.defra.gov.uk/page-2894>

⁴² Mander & Cutts (2005). Humber Estuary Low Tide Count Programme 2003-2004 available at: <http://publications.naturalengland.org.uk/publication/98018?category=43007>

- Dunlin (overwinter and passage) – confirmed presence in the Zol⁴³; preferring estuarine mudflat during non-breeding season.
- Black-tailed godwit (overwinter and passage) – confirmed presence in the Zol⁴⁴; common in intertidal areas during winter.
- Redshank (overwinter and passage) – confirmed presence in the Zol⁴⁵; during the winter it is largely coastal, occupying habitats including saltmarshes and tidal estuaries. Terrestrial surveys including the proposed option site recorded use by redshank⁴⁶.
- Waterfowl assemblage.

4.2.9 Qualifying mammal and amphibian species of the Humber Estuary within the Zone of Influence

The Humber Estuary supports the second largest breeding colony of grey seal (Ramsar Criterion 3) in England at Donna Nook, but it is not thought that this species would be present in the Zol of the option, approximately 20km upstream.

The dune slacks at Saltfleetby-Theddlethorpe is a known breeding site of the natterjack toad (Ramsar Criterion 3), but it is not thought that this species would be present in the Zol as it lacks the typical standing freshwater habitat required by this species.

4.2.10 Qualifying fish species of the Humber Estuary within the Zone of Influence

The Humber Estuary acts as an important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas, qualifying under Ramsar Criterion 8. Both species are present in the estuary to some degree, although numbers increase from summer to autumn when migrations take place. Both these Annex II species are listed as qualifying features of the Humber Estuary SAC. River and sea lamprey have been previously recorded along the Humber Estuary⁴⁷, with the Zol therefore having the potential to be in their migration route.

4.3 Potential Impacts of SHB2 Pyewipe Water Reuse for Non-Potable Use

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UKWIR guidance (Table 4).

There is uncertainty with regards to whether the infrastructure related to the implementation of the option would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size and scale of the proposed Pyewipe Water Reuse option, the impacts with the potential to result in adverse effects are:

Construction impacts

- Non-physical disturbance

⁴³ Cutts, N. and Hemingway, K. (2016). Humber Estuary High Tide Roost Review 2013-2014. Available at: <http://humburnature.co.uk/admin/resources/final-htrr-report-2013-14.pdf>

⁴⁴ Cutts, N. and Hemingway, K. (2016). Humber Estuary High Tide Roost Review 2013-2014. Available at: <http://humburnature.co.uk/admin/resources/final-htrr-report-2013-14.pdf>

⁴⁵ Cutts, N. and Hemingway, K. (2016). Humber Estuary High Tide Roost Review 2013-2014. Available at: <http://humburnature.co.uk/admin/resources/final-htrr-report-2013-14.pdf>

⁴⁶ Humber Nature Partnership (2016). Available at: <http://jncc.defra.gov.uk/page-2894>

⁴⁷ Franco A. (2015). Lamprey in the Humber. From Humber Nature Forum Meeting. Available at: <http://www.humburnature.co.uk/admin/resources/2015ohumber-nature-forum-mtqlamprey-in-the-humber.pdf>

- Noise disturbance
- Visual presence
- Light pollution
- Air pollution

Operational Impacts

- Toxic contamination
 - Water pollution

Details of each of the potential adverse effect are given below, with the sensitivity of the qualifying species of the European sites considered. An assessment of how the impact might affect the integrity of the sites is made, in view of the sites' structure, function and conservation objectives. Where adverse impacts are deemed significant, mitigation measures are proposed in Section 4.5.

4.3.1 Construction Effects

4.3.1.1 Non-physical Disturbance

Noise Disturbance

A pathway exists for noise disturbance during the construction of the option to result in a change in the number and distribution of species within the ZOI. The construction of the new WRTW and extension of the WTW and the components of the underground pipeline from Pyewipe to Immingham within 500m of the Humber Estuary are likely to involve construction methods known to be a particular issue in relation to disturbance to wetland birds⁴⁸, with noise levels above 70db(A) at the receptor likely to cause moderate to high effects. In general, birds tend to habituate to continual noises so long as there is no large amplitude 'startling' component, with vehicle movements being more greatly tolerated⁴⁹.

The additional outflow pipeline required to connect the new WRTW to the existing outfall is unlikely to be significant in length and construction will be localised and small-scale in nature. Therefore, unlikely to result in significant disturbance to the interest features of the designated sites.

Noise disturbance through the operation of the option is not considered given the location of the new infrastructure within an industrial area of the Humber bank zone, already subject to considerable noise levels.

Visual Presence

A pathway exists in the form of visual disturbance relating to the ability of the birds to view human activity and the possibility that they may be disturbed by increased movement during construction. The distance in which birds take flight when approached by people walking varies significantly. A review by Borgmann⁵⁰ found flight initiation distance ranged from 12 to 160m, whereas Cutts et al⁵¹ observed flight initiation at 200m. This disturbance impact is likely to occur

⁴⁸ Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R. & Treweek, J. (1997). Bird disturbance: improving the quality and utility of disturbance research. *J. Appl. Ecol.* 34: 275–288.

⁴⁹ Hockin, D., Ounsted, M., Gorman, M., Hill, D., Keller, V. & Barker, M.A. (1992). Examination of the effects of disturbance on birds with reference to its importance in ecological assessments. *J. Environ. Manage.* 36: 253–286.

⁵⁰ Borgmann, K.L. (2011). A Review of Human Disturbance Impacts on Waterbirds. [pdf] Available at: <http://www.yourwetlands.org/pdf/A%20Review%20of%20Human%20Disturbance%20Impacts%20on%20Waterbirds.pdf> [30th August 2017].

⁵¹ Cutts, N., Phelps, A. & Burdon, D. (2009). Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance. The University of Hull, Hull.

during construction of the new WRTW, the extension of the WTW and the construction of the components of the transfer pipeline within 500m of the boundary of the Humber Estuary.

Impacts from visual disturbance are not reasonably foreseeable during the operational phase, as the proposed WRTW and associated new transfer pipelines are located in areas already developed for industry where there is considerable current human presence. It is not considered that the operation of the new WRTW will escalate visual disturbance in this setting to any significant degree.

Light Pollution

The use of artificial lighting during construction (and operation) can result in light spill, with an overall increase in light levels within the ZoI resulting in the potential change in behaviour of birds, resulting in displacement. There is a potential for the construction of the WRTW, extension of the WTW and the components of the transfer pipeline within 500m of the boundary of the Humber Estuary, to result in light pollution.

Air Pollution

Air pollution can result from the release of particulate matter (dust) into the atmosphere or through exhaust emissions from vehicles. Developments associated with the option are likely to involve dust generating activities during the construction phase of the desalination plant and associated pipelines, thereby increasing air pollution in the area. A pathway affecting the European sites may exist depending on the distance at which significant dust effects are likely to occur. While this is dependent on the extent and nature of mitigation measures, the prevailing wind direction, and rainfall, effects from construction activities that generate dust are generally limited to within 150-200m of the construction site boundary⁵².

Therefore, there is potential for the proposed option to impact the qualifying habitats of the European sites through air pollution arising from the construction of pipelines which are within these sites. Additionally, despite the proposed desalination plant being approximately 400m from the site, it is located within functionally linked land known to support qualifying bird species of the Humber Estuary SPA and Ramsar sites.

Non-Physical Disturbance: Adverse Effects on Site Integrity

Given the habitats present in the ZoI, the interest features of the European sites which may experience adverse effects through non-physical disturbance are:

- Humber Estuary SPA:
 - Breeding, over-wintering and passage populations of European importance: avocet, golden plover, bar-tailed godwit, little tern, ruff (use intertidal and estuarine habitat which are present in the Humber Estuary and are sensitive to all potential non-physical disturbance impacts).
 - Migratory species of European importance: shelduck, knot, dunlin, sanderling, redshank (use intertidal and estuarine habitat which are present in the Humber Estuary and are sensitive to all potential non-physical disturbance impacts).
 - Congregatory waterfowl (use intertidal and estuarine habitat which are present in the Humber Estuary and are sensitive to all potential non-physical disturbance impacts).
- Humber Estuary Ramsar site:

⁵² Highways Agency 2007, Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, HA207/07 (Air Quality). Available at: <<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20707.pdf>> [Accessed 22 November 2017].

- Ramsar Criterion 5 (waterbird assemblage of international importance may be sensitive to all potential non-physical disturbance impacts).
- Ramsar Criterion 6 (waterbird species of European importance may be sensitive to all potential non-physical disturbance impacts).

4.3.2 Operational Effects

4.3.2.1 Toxic Contamination

Water Pollution

During operation of the option, there will be an increase in the volume of raw water effluent discharged from the existing WTW outfall to the Humber Estuary. It is understood that the preliminary design of the option will ensure that the final effluent quality to the existing discharge location is not materially deteriorated and the concentrations of key consented and non-consented parameters in the existing discharge is not worsened⁵³.

If a water pollution incident should occur however, a pathway therefore exists to impact these European sites and may cause adverse effects on the qualifying habitat features, with potential knock-on impacts on the qualifying bird and lamprey species. Water pollution has already been identified as a pressure impacting the Humber Estuary SPA and SAC sites, with any pollution impacts from the proposed option therefore having the potential to exacerbate this.

Toxic Contamination: Adverse Effects on Site Integrity

The interest features of the European sites which may experience adverse effects through toxic contamination are:

- Humber Estuary SPA:
 - Breeding, over-wintering and passage populations of European importance: avocet, golden plover, bar-tailed godwit, little tern, ruff. These species use intertidal and estuarine habitat for breeding feeding or loafing – these habitats are sensitive to pollution impacts, with water and air pollution already listed as a threat to the Humber Estuary.
 - Migratory species of European importance: shelduck, knot, dunlin, sanderling, redshank. These species use intertidal and estuarine habitat for feeding – these habitats are sensitive to pollution impacts, with water and air pollution already listed as a threat to the Humber Estuary. Contamination could affect the birds' food source, potentially moving up the food chain.
 - Congregatory waterfowl. These birds use intertidal and estuarine habitat which are present in the Humber River and are sensitive to pollution impacts, with water and air pollution already listed as a threat to the Humber Estuary, see section. Contamination could affect the birds' food source.
- Humber Estuary Ramsar site:
 - Ramsar Criterion 1. Estuarine waters and intertidal mud are sensitive to pollution impacts, with water and air pollution already listed as a threat to the Humber Estuary.
 - Ramsar Criterion 5. Supporting habitat of waterbird assemblage of international importance may be impacted by pollution events in the river channel of the Humber Estuary.
 - Ramsar Criterion 6. Supporting habitat of waterbird species of international importance may be impacted by pollution events in the river channel of the Humber Estuary.

⁵³ Mott MacDonald (2017). WRMP Pyewipe Reuse Technical Note. Prepared as an interim report for Anglian Water 22/11/17

- Ramsar Criterion 8. The riverine habitat through which river lamprey and sea lamprey pass is sensitive to pollution impacts.
- Humber Estuary SAC:
 - Estuaries. Mudflats and sandflats within the Humber Estuary are sensitive to pollution impacts, with water and air pollution already listed as a threat to the Humber Estuary.
 - River lamprey and sea lamprey (the river habitat through which river lamprey and sea lamprey pass is sensitive to pollution impacts).

4.4 Summary of Potential Impacts of the Option

The assessment of the SHB2 Pyewipe water reuse option given in Section 4.3 has identified potential impacts that are considered likely to result in adverse effects on the integrity of the European sites as defined by their conservation objectives, as per European Commission guidance⁵⁴. These are summarised in Table 18 below.

Table 18: Summary of potential adverse effects of Pyewipe Water Reuse for non-potable use option on European sites

European site	Potential adverse impact	Sensitive interest feature	Permanent or temporary
Humber Estuary SPA	Non-physical disturbance (light/visual presence/noise) through construction of Pyewipe WRC and transfer pipeline Toxic contamination (water and air pollution) through construction and operation of discharge outfall. Impact relates to potential pollution events	Breeding, overwintering and passage species (avocet, golden plover, bar-tailed godwit, little tern, ruff) Migratory species (shelduck, knot, dunlin, sanderling, redshank). Congregatory waterfowl	Disturbance temporary during construction only Toxic contamination temporary through construction and operation
Humber Estuary Ramsar site	Non-physical disturbance (light/visual presence/noise) through construction of Pyewipe WRC and transfer pipeline Toxic contamination (water and air pollution) through construction and operation of discharge outfall. Impact relates to potential pollution events	Ramsar Criterion 1 (near-natural wetland habitat including dune systems, estuarine waters, intertidal mud and sand flats, saltmarsh and coastal/brackish lagoons) Ramsar Criterion 5 (waterbird assemblage of international importance) Ramsar Criterion 6 (water bird species of European importance, i.e. golden plover, red knot, dunlin, black-tailed godwit, bar-tailed godwit, redshank, shelduck). Ramsar Criterion 8 (river and sea lamprey)	Disturbance temporary during construction only Toxic contamination temporary through construction and operation
Humber Estuary SAC	Toxic contamination (water and air pollution) through construction and operation of discharge outfall. Impact relates to potential pollution events	Estuarine habitat River and sea lamprey	Toxic contamination temporary through construction and operation

⁵⁴ European Commission (2002). Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. European Commission, Brussels

4.5 Conclusions and Recommendations

4.5.1 Background

The SHB2 Pyewipe water reuse option proposes to transfer non-potable water from Pyewipe WRC located in Grimsby Port, to the new Pyewipe WRTW through a new pipeline. The water is then treated and transferred to the demand hub (Immingham demand hub) ready to be used via a new 19km pipeline. The remainder of the treated effluent water is pumped out into the Humber estuary via an outflow pipeline, located downstream at Grimsby Port. The construction and commissioning phase of the option will last two years (18 months' construction/six months commissioning).

4.5.2 Summary of Potential Impacts

A HRA Task II: Appropriate Assessment considered the impact of the plan on the integrity of Natura 2000 sites in the Zol with respect to the conservation objectives of each site, its structure and function. The Task II: Appropriate Assessment can be addressed in answer to the following questions:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed WRMP option is not within the boundary of a European site.

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as being in hydrological continuity with the proposed WRMP option:

- The Humber Estuary SPA;
- The Humber Estuary Ramsar site;
- The Humber Estuary SAC.

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s), either directly or indirectly?

The assessment has identified that there is a likelihood for temporary adverse effects on the Humber Estuary SPA/Ramsar site/SAC during construction and operation of the option. These impacts relate to (1) possible disturbance to qualifying bird species of the SPA/Ramsar site during construction of the new WRTW, the extension of the WTW and the components of the underground pipeline, and (2) pollution events during construction and operation of the discharge outfall resulting in adverse effects on water quality and entering the Humber Estuary and air pollution affecting aquatic habitats, bird and fish species of the SPA/Ramsar site/SAC.

4.5.3 Proposed Mitigation Measures

The full extent to which mitigation will be required will be determined at a lower-tier assessment, when finalised detailed design is available and an appropriate project-level HRA is undertaken. Anglian Water is committed to implementing the following mitigation measures and/or other mitigation measures should they be considered more appropriate at the project stage. The likelihood that appropriate mitigation cannot be incorporated into the design to minimise the impacts identified is low. The following mitigation measures are recommended:

- Noise disturbance:
 - Construction activities within 500m of The Humber Estuary will be programmed to avoid seasons for qualifying bird species. This should be based on baseline bird surveys but is likely to entail avoiding the breeding season (for breeding species such as bittern, marsh

harrier, avocet, little tern) and avoiding the key overwintering period for migratory and non-breeding species (i.e. hen harrier, golden plover, bar-tailed godwit, ruff, shelduck, knot, dunlin, sanderling, redshank). If timescales allow and works can be completed between August and November, this would avoid both the breeding and overwintering periods and disturbance effects would be avoided.

- Construction related noise disturbance will be further minimised by implementing best practice such as BS 5228-1:2009+A1:2014⁵⁵.
- Visual (human) presence
 - Construction activities within 500m of The Humber Estuary will be programmed to avoid seasons for qualifying bird species. This should be based on baseline bird surveys but is likely to entail avoiding the breeding season (for breeding species such as bittern, marsh harrier, avocet, little tern) and avoiding the key overwintering period for migratory and non-breeding species (i.e. hen harrier, golden plover, bar-tailed godwit, ruff, shelduck, knot, dunlin, sanderling, redshank). If timescales allow and works can be completed between August and November, this would avoid both the breeding and overwintering periods and disturbance effects would be avoided.
 - If construction work within this timeframe and area cannot be avoided, low level screening will be constructed along the boundary of the site to prevent birds viewing the operational areas, thereby preventing visual and human disturbance.
- Light pollution:
 - Should the works be undertaken at night and flood lighting required, lighting will be kept to a minimum and hooded spot lights directed away from potential suitable habitat, to reduce disturbance while ensuring standards for health and safety.
 - The potential impact of artificial light will be minimised through the implementation of best practice such as 'Guidance Notes for the Reduction of Obtrusive Light' ⁵⁶.
- Water pollution:
 - Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW) ⁵⁷.
- Air pollution:
 - Implement measures set out in the Institute of Air Quality Management 'Guidance on the assessment of dust from demolition and construction'⁵⁸.

4.5.4 Summary of Task II: Appropriate Assessment

For the impacts identified during construction and operation, appropriate mitigation measures will be put in place to ensure there is no residual effects on the qualifying features of the

⁵⁵ The British Standards Institute (2008). BS 5228-1:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise. BSI Standards Limited, London.

⁵⁶ Institute of Lighting Professionals (2011). Guidance notes for the reduction of obtrusive light. Available at: <http://www.wiltshire.gov.uk/guidance-notes-for-the-reduction-of-obtrusive-light.pdf>. [Accessed 30th August 2017]

⁵⁷ GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in [GPP 5: Works and maintenance in or near water](http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf) (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

⁵⁸ Holman et al (2014). IAQM Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London

European sites identified in the ZoI. No significant adverse effects are reasonably foreseeable on the integrity of European sites as a result of operation if mitigation measures are employed.

The overall likelihood of adverse impacts of the Pyewipe Water Reuse for non-potable use option on the qualifying features are summarised in Table 19.

Table 19: Assessment of potential adverse impacts of Pyewipe Water Reuse for non-potable use option on the European qualifying features within the ZoI (✓ = adverse impact cannot be excluded; X = adverse impact can be excluded; X^m= adverse impact may be excluded following appropriate mitigation)

		Potential impacts of SHB2 Pyewipe Water Reuse for Non-Potable use							
Qualifying feature	European sites	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and flows	Change in salinity	Changes to habitat availability
Bittern	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Marsh harrier	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Avocet	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Golden plover	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Bar-tailed godwit	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Little tern	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Ruff	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Shelduck	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Knot	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Dunlin	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Black-tailed godwit	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Redshank	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Waterbird assemblage	Humber Estuary SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Natural or near-natural wetlands (Ramsar Criterion 1)	Humber Estuary Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Supports important plant and animal species (Ramsar Criterion 3)	Humber Estuary Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X

Potential impacts of SHB2 Pyewipe Water Reuse for Non-Potable use

Qualifying feature	European sites	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and flows	Change in salinity	Changes to habitat availability
Supports waterbirds (Criterion 5)	Humber Estuary Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Regularly supports 1% of the individuals in a population (Criterion 6)	Humber Estuary Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Acts as a migratory route (Criterion 8)	Humber Estuary Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Estuaries	Humber Estuary SAC	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X
Mudflats/sandflats	Humber Estuary SAC	X ^m	X ^m	X ^m	X ^m	X ^m	X	X	X

5 ESU2 – Ipswich Water Reuse

5.1 Option Description

Sub-option A of the Ipswich water reuse option involves construction of a new WRTW, adjacent to the existing Cliff Quay WRC. The WRC currently discharges RO concentrate into the River Orwell via an existing pipeline. A newly constructed section of pipeline will connect the existing WRC to the new WRTW, eventually connecting to the existing pipeline infrastructure near the discharge point.

A 10km transfer pipeline will carry treated potable water from the newly constructed Cliff Quay WRTW to a new outflow located upstream on the River Gipping. Water will then be abstracted from a new intake downstream of this discharge point and taken via a new 13km pipeline to Alton Reservoir. Water will be taken from Alton reservoir via a new pipeline, to a new WTW at Alton, for treatment, before joining the water supply network.

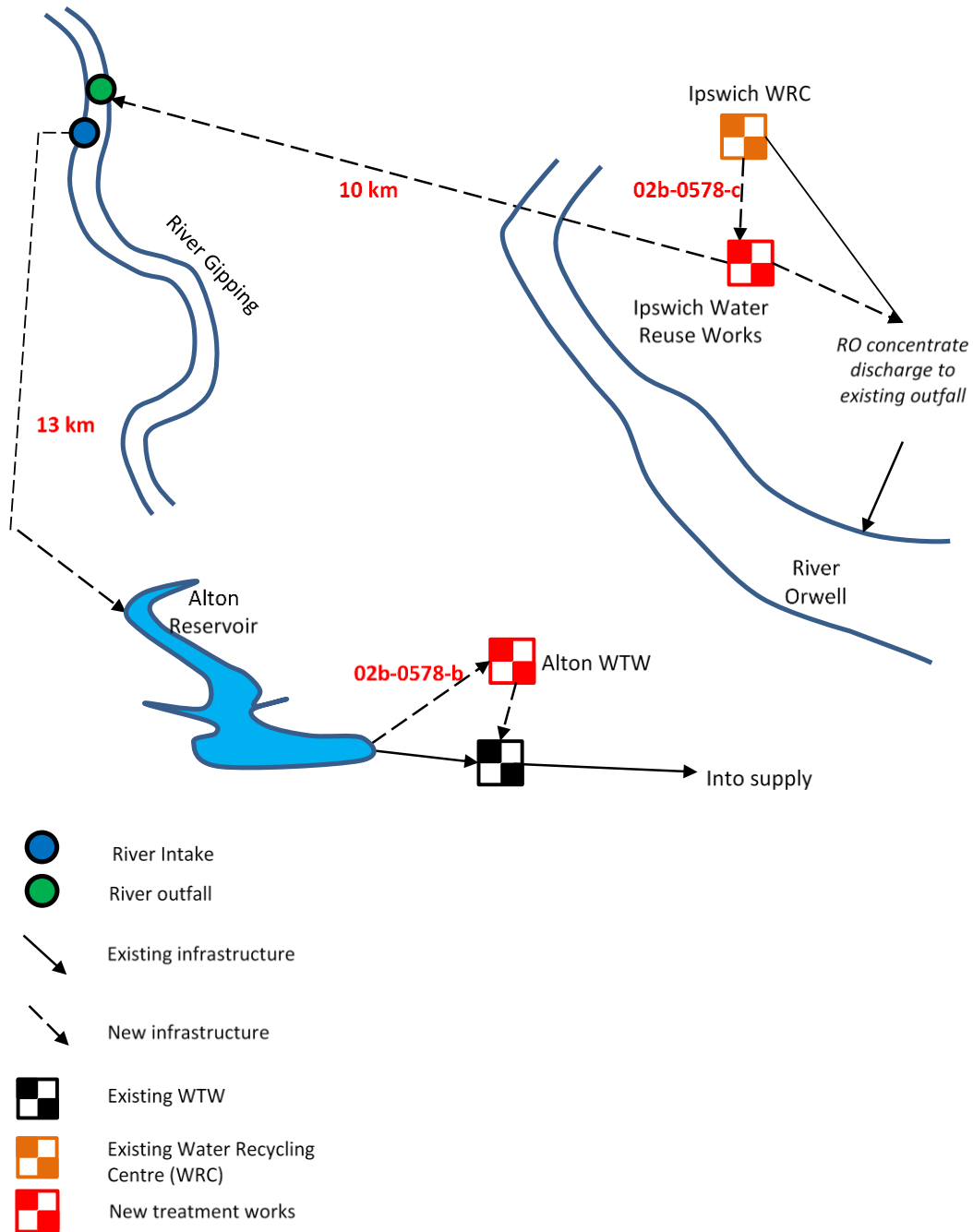
The pipeline from Cliff Quay WRTW to the River Gipping outfall is approximately 10km in length. The pipeline from the River Gipping intake to Alton Reservoir is approximately 13km in length.

Pipelines from the Alton Reservoir to Alton WTW and Cliff Quay WRC to the WRTW have no specific route as they are expected to be short in length, connecting nearby infrastructure. These routes have therefore not been assessed.

Sub-options A and B both use the same raw water source. However, sub-option B does not involve the construction of a new pipeline from the River Gipping to Alton Reservoir, or the construction of a new WTW or the associated pipeline from Alton Reservoir to Alton WTW. It therefore does not cause any of the effects associated with these works. The schematic for ESU2 presented in Figure 4.

It is assumed that the construction and commissioning phase of the option will last two years (18 months for construction and six months for commissioning), the equivalent of the short-term significance of the effect.

Figure 4: Ipswich Option Schematic – Sub-option A



Source: Anglian Water (August 2018)

5.2 Designated Sites in the Zone of Influence

The Task I: Screening assessment identified two European sites in the ZoI of this option. These are:

- Stour and Orwell Estuaries Special Protection Area (SPA);
- Stour and Orwell Estuaries Ramsar site.

The option is shown in relation to these European sites in Appendix B.

5.2.1 Stour and Orwell Estuaries SPA

The Stour and Orwell estuaries are located at the border between Essex and Suffolk. The estuaries include extensive mud-flats, low cliffs, saltmarsh, and small areas of vegetated shingle on the lower reaches. The mud-flats hold *Enteromorpha*, *Zostera* and *Salicornia* spp. The site also includes an area of low-lying grazing marsh at Shotley Marshes on the south side of the Orwell. In summer, the site supports important numbers of breeding avocet *Recurvirostra avosetta*, while in winter they hold major concentrations of waterbirds.

This site qualifies as an SPA under Article 4.1 of the Directive (79/409/EEC) by supporting over-wintering populations of European importance of the species listed on Annex I of the Directive:

Table 20: Stour and Orwell Estuaries Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Hen Harrier <i>Circus cyaneus</i>		x	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Table 21: The Humber Estuary migratory species of international importance (SPA)

Article 4.2 interest feature	Breeding	Over winter	Passage
Pintail <i>Anas acuta</i>		x	
Dunlin <i>Calidris alpina alpina</i>		x	
Black-tailed godwit <i>Limosa limosa islandica</i>		x	
Grey plover <i>Pluvialis squatarola</i>		x	
Redshank <i>Tringa tetanus</i>		x	
Ringed plover <i>Charadrius hiaticula</i>		x	
Shelduck <i>Tadorna tadorna</i>		x	
Turnstone <i>Arenaria interpres</i>		x	
Over winter, the area regularly supports at least 20,000 individual waterfowl (5 year peak mean 1991/2 - 1995/6)	Cormorant, Pintail, Ringed Plover, Grey Plover, Dunlin, Black-tailed Godwit, Redshank, Shelduck, Great Crested Grebe, Curlew, Dark-bellied Brent Goose, Wigeon, Goldeneye, Oystercatcher, Lapwing, Knot, Turnstone.		

Sub-features (habitats) have also been identified within the European marine site in the Stour and Orwell Estuaries. The key sub-features are:

- Saltmarsh – used by golden plovers for roosting, particularly on the Stour Estuary. The saltmarshes of the Stour, grade from high marsh with species such as sea purslane *Atriplex*

portulacoides, sea aster, *Aster tripolium*, and annual sea blite *Suaeda maritima* through to lower marsh dominated by glasswort *Salicornia sp* and cord grasses *Spartina spp*.

- Intertidal mudflat – the mudflats of the Stour Estuary are all rich in invertebrates, relatively undisturbed and are used by golden plovers for feeding.

5.2.2 Stour and Orwell Estuaries Ramsar site

The Stour and Orwell Estuaries is a wetland of international importance, comprising extensive mudflats, low cliffs, saltmarsh, and small areas of vegetated shingle on the lower reaches. In addition to the habitats and birds it supports, the site holds several nationally scarce plants and British Red Data Book invertebrates.

The site qualifies for inclusion as a Ramsar site under three criteria of the Ramsar Convention on Wetlands of International Importance⁵⁹, as summarised in Table 22.

Table 22: The Stour and Orwell Estuaries Ramsar Site

Criterion	Qualifying Features of the Ramsar site	Notes
2	Supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	Contains seven nationally scarce plants: stiff saltmarsh-grass <i>Puccinellia rupestris</i> ; small cord-grass <i>Spartina maritima</i> ; perennial glasswort <i>Sarcocornia perennis</i> ; lax-flowered sea lavender <i>Limonium humile</i> ; and the eelgrasses <i>Zostera angustifolia</i> , <i>Z. marina</i> and <i>Z. nolt</i> Contains five British Red Data Book invertebrates: the muscid fly <i>Phaonia fusca</i> ; the horsefly <i>Haematopota grandis</i> ; two spiders, <i>Arctosa fulvolineata</i> and <i>Baryphema duffeyi</i> ; and the Endangered swollen spire snail <i>Mercuria confusa</i> .
5	Regularly supports 20,000 or more waterbirds	Species with peak counts in winter: 63017 waterfowl (5 year peak mean 1998/99-2002/2003)
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Species with peak counts in spring/autumn: common redshank Species with peak counts in winter: dark-bellied brent goose, northern pintail, grey plover, red knot, dunlin, black-tailed godwit, common redshank

5.2.3 Conservation Objectives of the Stour and Orwell Estuaries

The conservation objectives of The Stour and Orwell Estuaries SPA/Ramsar site⁶⁰ are to ensure that the site contributes to achieving the aims of the Wild Birds Directive. These objectives will be met by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

⁵⁹ JNCC (2007). Ramsar Information Sheet: UK11067. Stour and Orwell Estuaries. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11067.pdf>.

⁶⁰ Natural England (2014). European Site Conservation Objectives for Stour and Orwell Estuaries SPA Site Code: UK9009121. Publication date: 30 June 2014 (Version 2). This document updates and replaces an earlier version dated 29 May 2012. Previous references to additional features identified in the 2001 UK SPA Review have been removed.

5.2.4 Vulnerability of the Stour and Orwell Estuaries

The Stour and Orwell Estuaries are subject to the impacts of erosion due to natural processes which are being exacerbated by fixed sea defences and port development. The key issues identified in the Site Improvement Plan for the SPA⁶¹ and the Ramsar Information Sheet are:

- Coastal squeeze causing loss and degradation of habitats due to the presence of coastal defences and sea level rise.
- Public access and disturbance from a range of land- and water-based activities causing disturbance Impacts on waterbirds.
- Changes in species distribution shown by decreases in some of the species of birds present.
- Invasive species such as *Spartina anglica*, which may be impacting *Spartina maritima* and altering bird roosting and feeding areas of saltmarsh and mudflat.
- Numerous, small developments, development outside of the SPA and pressures to relax planning conditions on existing developments.
- Air pollution impacts, with the level of nitrogen deposition currently exceeding site-relevant critical loads.
- Freshwater habitat areas behind failing sea walls could be inundated by seawater.
- Pressures from commercial marine and estuarine fisheries.

5.2.5 Qualifying habitats of the Stour and Orwell Estuaries SPA/Ramsar within the Zone of Influence

For both sub-options, the proposed pipeline from the newly constructed Cliff Quay WRTW to the outflow on the River Gipping crosses the River Orwell just upstream of the northern end of the Stour and Orwell Estuaries SPA/Ramsar site. There are six SSSI units within the Orwell Estuary SSSI that lie within 5km of the new pipeline, which provide information about the habitats and their condition within the Zol.

The SSSI units within the Zol contain the following habitats listed in the citation for the SPA and Ramsar site: mud-flats, low cliffs, saltmarsh and small areas of vegetated shingle. One of these units (Redgate Hard, Unit 1), located adjacent to the pipeline route, was assessed as being in 'unfavourable – declining' condition in 2009, due to coastal squeeze. A decrease in saltmarsh area has been observed in aerial photographs and the front edge of salt marsh is shown to be eroding. There are also small patches of *Spartina anglica* growing within this area⁶². The threats of coastal squeeze and invasive species are further reflected in the vulnerabilities outlined in the SPA and Ramsar citations for the Stour and Orwell Estuaries.

The River Orwell Channel SSSI unit (Unit 18; located adjacent to the pipeline route) is dredged approximately once a year to maintain navigation requirements. Dredging represents a risk of physical damage and indirect losses due to erosion, changes in sediment structure, noise/visual disturbance, disposal of dredged material causing siltation/smothering of habitats, and potential release of contaminants through sediment redistribution. However, a licence agreement is in place to manage the dredging operations, which takes environmental considerations in to account, meaning that the site is still in 'favourable' condition⁶³.

⁶¹ Natural England (2015). Site Improvement Plan – Stour and Orwell Estuaries. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

⁶² Orwell Estuary SSSI – Redgate Hard (001) Condition Assessment:
<https://designatedsites.naturalengland.org.uk/UnitDetail.aspx?UnitId=1009576>

⁶³ Orwell Estuary SSSI – River Orwell Channel (018) Condition Assessment:
<https://designatedsites.naturalengland.org.uk/UnitDetail.aspx?UnitId=1025852>

5.2.6 Qualifying bird species of the Stour and Orwell Estuaries within the Zone of Influence

All the qualifying bird species of Stour and Orwell Estuaries SPA and Ramsar sites have either been recorded during condition assessment surveys or have the potential to be supported by the habitats present. All the following species are therefore screened in to this appropriate assessment:

- Black-tailed godwit
- Dunlin
- Grey plover
- Pintail
- Redshank
- Ringed plover
- Shelduck
- Turnstone
- Brent goose
- Red knot

5.3 Potential impacts of ESU2 Ipswich Water Reuse

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UKWIR guidance.

There is uncertainty with regards to whether the infrastructure related to the implementation of the option would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size, and scale of the proposed Ipswich Water Reuse option, the impacts with the potential to result in adverse effects are:

Construction impacts

- Physical damage
 - Habitat degradation
- Non-physical disturbance
 - Noise disturbance
 - Visual presence
 - Light pollution
- Toxic contamination
 - Water pollution

Operation impacts

- Water table/ availability
 - Changes to surface water levels and flows
- Non-toxic contamination
 - Changes in salinity

Details of each of the potential impacts are given below, with the sensitivity of the qualifying species of the European sites considered. An assessment of each potential impact on the integrity of the sites are made, in view of the sites' structure, function and conservation objectives. Where adverse impacts are deemed significant, mitigation measures are proposed in subsequent sections.

5.3.1 Construction effects

5.3.1.1 Physical damage

Habitat Degradation

The proposed option crosses the River Orwell adjacent to the northern boundary of the Stour and Orwell Estuary SPA and Ramsar sites, therefore it is likely that the construction of these pipelines will require the use of heavy machinery within the estuary channel. This is beyond the boundary of the European sites, therefore no direct habitat loss within the European sites is anticipated. However, the area is functionally linked to the sites as it is known to support qualifying bird species, with construction of the pipeline having the potential to cause the deterioration of habitats supporting these species. This may intensify pressures on the site which are already in place from coastal squeeze and erosion.

Physical Damage: Adverse effects on site integrity

The interest features of the European sites which may experience adverse effects through habitat degradation are:

- Stour and Orwell Estuary SPA:
 - Over-wintering populations of European importance: black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier (use mudflat and intertidal habitats which are present in the River Orwell and may be impacted by construction).
 - Congregatory waterfowl (use intertidal habitats which are present in the River Orwell and may be impacted by construction).
- Stour and Orwell Estuary Ramsar site:
 - Ramsar Criterion 1 (saltmarsh plants and aquatic invertebrates present in the channel may be impacted by construction).
 - Ramsar Criterion 5 (supporting habitat of waterbirds may be impacted by construction in the river channel of the estuary).
 - Ramsar Criterion 6 (supporting habitat of waterbirds may be impacted by construction in the river channel of the estuary).

5.3.1.2 Non-physical disturbance

Noise Disturbance

A pathway exists for noise disturbance during the construction of the option to result in a change in the number and distribution of species within the Zol. The construction of the new pipeline from the new Cliff Quay WRTW to the River Gipping (02a-0578) is likely to involve construction methods such as directional drilling, some of which will be within the River Orwell. Construction methods are known to be a particular issue in relation to disturbance to wetland

birds⁶⁴, with noise levels above 70db(A) at the receptor likely to cause moderate to high effects. In general, birds tend to habituate to continual noises so long as there is no large amplitude 'startling' component, with vehicle movements being more greatly tolerated⁶⁵.

Additionally, construction of the new WRTW on the east bank of the River Orwell is within 500m of the boundary of the European sites and has the potential to cause noise disturbance impacting the qualifying bird species of the designated sites. The treated effluent water that will not be required by supply will be pumped into the River Orwell via an existing outfall located downstream. An outflow pipeline will be required to connect the new WRTW to this outfall; this is unlikely to be significant in length and construction will be localised and small-scale in nature and therefore unlikely to result in significant disturbance to the interest features of the designated sites.

Noise disturbance through the operation of the option is not considered given the location of the new infrastructure within an industrial area of the Cliff Quay, which is already subject to considerable baseline noise levels.

Visual Presence

A pathway of visual disturbance exists, relating to the ability of the birds to view human activity and the possibility that they may be disturbed by increased movement during construction. The distance in which birds take flight when approached by people walking varies significantly. A review by Borgmann⁶⁶ found flight initiation distance ranged from 12 to 160m, whereas Cutts et al⁶⁷ observed flight initiation at 200m. This disturbance impact is likely to occur during construction of the new pipeline.

Impacts from visual disturbance are not reasonably foreseeable during the operational phase, as the proposed WRTW and associated new transfer pipelines are located in areas already developed for industry where there is considerable current human presence. The operation of the new WRTW therefore has no reasonably foreseeable likely significant effect from visual disturbance.

Light Pollution

The use of artificial lighting during construction and operation can result in light spill, with a pathway existing through an overall increase in light levels within the ZoI, with the potential to change the behaviour of birds and result in displacement. There is a potential pathway for impact from the construction of pipeline route 02a-0578, as the route runs along the northern edge of the Stour and Orwell Estuaries SPA and Ramsar site, within the river channel.

Non-physical disturbance: Adverse effects on site integrity

The interest features of the European sites which may experience adverse effects through non-physical disturbance are:

- Stour and Orwell Estuary SPA:

⁶⁴ Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R. & Treweek, J. (1997). Bird disturbance: improving the quality and utility of disturbance research. *J. Appl. Ecol.* 34: 275

⁶⁵ Hockin, D., Ounsted, M., Gorman, M., Hill, D., Keller, V. & Barker, M.A. (1992). Examination of the effects of disturbance on birds with reference to its importance in ecological assessments. *J. Environ. Manage.* 36: 253–286.

⁶⁶ Borgmann, K.L. (2011). A Review of Human Disturbance Impacts on Waterbirds. [pdf] Available at: <http://www.yourwetlands.org/pdf/A%20Review%20of%20Human%20Disturbance%20Impacts%20on%20Waterbirds.pdf> [30th August 2017]. 124

⁶⁷ Cutts, N., Phelps, A. & Burdon, D. (2009). Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance. The University of Hull, Hull.

- Over-wintering populations of European importance: black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier (use mudflat and intertidal habitats which are present and are sensitive to all potential non-physical disturbance impacts).
- Congregatory waterfowl (use intertidal habitats which are present in the River Orwell and are sensitive to all potential non-physical disturbance impacts).
- Stour and Orwell Estuary Ramsar site:
 - Ramsar Criterion 5 (waterbirds are sensitive to all potential non-physical disturbance impacts).
 - Ramsar Criterion 6 (waterbirds are sensitive to all potential non-physical disturbance impacts).

5.3.1.3 Toxic contamination

Water pollution

The proposed pipeline route 02a-0578 crosses the River Orwell adjacent to the SPA/Ramsar site. During the construction period, materials and machinery are therefore likely to be mobilised on the river banks directly upstream of the European sites. There is potential for pollution events to occur during construction, with a pathway to impact on the European sites. This may cause adverse effects on the qualifying bird, plant, and invertebrate species through changes in water quality and degradation of supporting habitats. Direct drilling of the pipeline under the river will mitigate impacts but best practice must still be observed.

Toxic contamination: Adverse effects on site integrity

The interest features of the European sites which may experience adverse effects through non-physical disturbance are:

- Stour and Orwell Estuary SPA:
 - Over-wintering populations of European importance: black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier (these species use intertidal and estuarine habitats for feeding or loafing – these are sensitive to pollution impacts).
 - Congregatory waterfowl (use intertidal habitats which are present in the River Orwell – these habitats are sensitive to pollution impacts).
- Stour and Orwell Estuary Ramsar site:
 - Ramsar Criterion 1 (saltmarsh plants and aquatic invertebrates present in the channel are sensitive to pollution impacts).
 - Ramsar Criterion 5 (the supporting habitats of these waterbirds are sensitive to pollution impacts).
 - Ramsar Criterion 6 (the supporting habitats of these waterbirds are sensitive to pollution impacts).

5.3.2 Operation effects

5.3.2.1 Water table/ availability

Changes to Surface Water Levels and Flows

This option should result in no net change in water flow, with output from the effluent treatment balancing the increased abstraction upstream in the River Gipping (the source river for the River

Orwell). However, there is the potential for localised changes in hydrology. For instance, redirection of effluent from Cliff Quay WRC for discharge into the River Gipping may decrease localised outfall into the River Orwell estuary.

The impact of this change on qualifying habitats and species will be dependent on the significance of the change in outfall. However, given the large volume of water in the estuary, its tidal variability, and as water availability has not been identified as a threat to the estuary in the SPA/Ramsar, it is considered unlikely that a change in the existing discharge would cause a deterioration in water quality. No likely significant effect from a change in water availability is therefore foreseeable on the qualifying features of the European sites.

Water Table/Availability: Adverse Effects on Site Integrity

Given the tidal nature of the Stour and Orwell estuary, freshwater input is only a minor contributor to levels and flows in the Stour and Orwell estuary. Consequently, no significant adverse effects from changes to surface water levels and flows are foreseeable on any of the qualifying features of the European sites.

5.3.2.2 Non-toxic Contamination

Changes in Salinity

Reverse osmosis concentrate from the new WRTW will be discharged at an existing outfall point in the River Orwell, which already discharges effluent from Cliff Quay WRC. However, the option has been designed so that the concentrate is blended with the existing WRC effluent to ensure that the estimated chloride in the discharge doesn't exceed the environmental quality standard (EQS) for chloride of 250mg/l.

With these measures in place, no likely significant effects from changes in water flow are anticipated. Further assessment of impacts should be undertaken if there are design changes to the above, or uncertainty over the levels of effluent discharge and concentrations.

Non-toxic Contamination: Adverse Effects on Site Integrity

Based on the information provided that outflow from the reuse works will not exceed the EQS, no adverse effects from changes in salinity are anticipated. Further assessments will be required if this is not found to be the case.

5.4 Summary of Potential Impacts of the Option

The assessment of the Ipswich Water Reuse option given has identified potential impacts that are considered likely to result in adverse effects on the integrity of the European sites as defined by their conservation objectives, as per European Commission guidelines. These are summarised in Table 23 below.

Table 23: Summary of potential adverse effects of Ipswich Water Reuse option on European sites

European site	Potential adverse impact	Sensitive interest feature	Permanent or temporary
Stour and Orwell Estuaries SPA	Habitat degradation through construction of transfer pipeline	Over-wintering populations (black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier); Congregatory waterfowl	Temporary during construction

European site	Potential adverse impact	Sensitive interest feature	Permanent or temporary
	Toxic contamination (specifically water pollution) through construction of transfer pipeline	Over-wintering populations (black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier); Congregatory waterfowl	Temporary during construction
	Non-physical disturbance (noise, visual and light) through construction of transfer pipeline and WRTW	Over-wintering populations (black-tailed godwit, dunlin, grey plover, pintail, redshank, ringed plover, shelduck, turnstone, hen harrier); Congregatory waterfowl	Temporary during construction
Stour and Orwell Estuaries Ramsar site	Habitat degradation through construction of transfer pipeline	Criterion 1 (saltmarsh plants and aquatic invertebrates); Criterion 5 (waterfowl congregation); Criterion 6 (redshank, brent goose, pintail, grey plover, red knot, dunlin, black-tailed godwit, common redshank)	Temporary during construction
	Toxic contamination (specifically water pollution) through construction of transfer pipeline	Criterion 1 (saltmarsh plants and aquatic invertebrates); Criterion 5 (waterfowl congregation); Criterion 6 (redshank, brent goose, pintail, grey plover, red knot, dunlin, black-tailed godwit, common redshank)	Temporary during construction
	Non-physical disturbance (noise, visual and light) through construction of transfer pipeline and WRTW	Criterion 5 (waterfowl congregation); Criterion 6 (redshank, brent goose, pintail, grey plover, red knot, dunlin, black-tailed godwit, common redshank)	Temporary during construction

5.5 Conclusions and Recommendations

5.5.1 Background

Sub-option A of the Ipswich Water Reuse option involves construction of a new WRTW, adjacent to the existing Cliff Quay WRC. The WRC currently discharges RO concentrate into the River Orwell via an existing pipeline. A newly constructed section of pipeline will connect the existing WRC to the new WRTW, eventually connecting to the existing pipeline infrastructure near the discharge point.

A 10km transfer pipeline will carry treated potable water from the newly constructed Cliff Quay WRTW to a new outflow located upstream on the River Gipping. Water will then be abstracted from a new intake downstream of this discharge point and taken via a new 13km pipeline to Alton Reservoir. Water will be taken from Alton reservoir via a new pipeline, to a new WTW at Alton, for treatment, before joining the water supply network.

Sub-options A and B both use the same raw water source. However, sub-option B does not involve the construction of a new pipeline from the River Gipping to Alton Reservoir, or the

construction of a new WTW or the associated pipeline from Alton Reservoir to Alton WTW. It therefore does not cause any of the effects associated with these works.

5.5.2 Summary of Potential Effects on European Sites

A HRA Task II: Appropriate Assessment considered the impact of the plan on the integrity of Natura 2000 sites in the Zol with respect to the conservation objectives of each site, its structure and function. The Task II: Appropriate Assessment can be addressed in answer to the following questions:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed WRMP option is not within the boundary of a European site.

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as being in hydrological continuity with the proposed WRMP option:

- Stour and Orwell Estuaries SPA
- Stour and Orwell Estuaries Ramsar site

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s), either directly or indirectly?

The assessment has identified that there is a likelihood for temporary adverse effects on the Stour and Orwell Estuaries SPA/Ramsar site during construction of the option. These impacts relate to (1) potential degradation of habitats supporting the qualifying bird species of the SPA/Ramsar site and qualifying plants and invertebrates of the Ramsar site during construction, (2) possible disturbance to qualifying bird species of the SPA/Ramsar site during construction, and (3) pollution events resulting in adverse effects on water quality and entering the Orwell Estuary affecting bird, plant and invertebrate species of the SPA/Ramsar site.

5.5.3 Proposed Mitigation Measures

The full extent to which mitigation will be required will be determined at a lower-tier assessment, when finalised detailed design is available and an appropriate project-level HRA is undertaken. Anglian Water is committed to implementing the following mitigation measures and/or other mitigation measures should they be considered more appropriate at the project stage. The likelihood that appropriate mitigation cannot be incorporated into the design to minimise the impacts identified is low. The following mitigation measures are recommended:

- Habitat degradation:
 - All construction activities within the River Orwell will be undertaken beyond the boundary of the European sites. This will prevent direct habitat loss and degradation on the footprint of the proposed option.
 - Best practice guidance will be implemented as detailed in the points below, to prevent degradation of functionally linked habitats.
- Water pollution:
 - Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish

Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW)⁶⁸.

- Noise disturbance:
 - Programme activities likely to result in disturbance (within 500m of Stour and Orwell Estuaries SPA and Ramsar site), outside of the bird over-wintering season, in the period October to February inclusive.
 - Construction related noise disturbance will be further minimised by implementing best practice such as BS 5228-1:2009+A1:2014⁶⁹.
- Light pollution:
 - Should the works be undertaken at night and flood lighting required, lighting will be kept to a minimum and hooded spot lights directed away from potential suitable habitat, to reduce disturbance while ensuring standards for health and safety.
 - The potential impact of artificial light will be minimised through the implementation of best practice such as 'Guidance Notes for the Reduction of Obtrusive Light'⁷⁰.
- Human presence:
 - Programme activities likely to result in disturbance (within 200m of Stour and Orwell Estuaries SPA and Ramsar site), outside of the bird over-wintering season, in the period October to February inclusive.
 - If construction work within this timeframe and area cannot be avoided, construct low level screening along the boundary of the site to prevent birds seeing into the operational areas, thereby preventing visual and human disturbance.

5.5.4 Summary of the Task II: Appropriate Assessment

For the impacts identified during construction, appropriate mitigation measures will be put in place to ensure there is no residual effects on the qualifying features of the European sites identified in the ZoI. No significant adverse effects are reasonably foreseeable on the integrity of European sites as a result of operation if mitigation measures are employed. The overall likelihood of adverse impacts of the Ipswich Water Reuse Option on the qualifying features are summarised in Table 24.

⁶⁸ GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in GPP 5: Works and maintenance in or near water (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

⁶⁹ The British Standards Institute (2008). BS 5228-1:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise. BSI Standards Limited, London

⁷⁰ Institute of Lighting Professionals (2011). Guidance Notes for the Reduction of Obtrusive Light GN01:2011

Table 24: Assessment of potential adverse impacts of Ipswich Water Reuse Option on the European qualifying features within the ZoI (✓ = adverse impact cannot be excluded; X = adverse impact can be excluded; Xm= adverse impact can be excluded following appropriate mitigation measures)

Potential Impacts of Ipswich Water Reuse

Qualifying feature	European sites	Potential Impacts of Ipswich Water Reuse						
		Habitat degradation	Noise Disturbance	Visual Presence	Light Pollution	Water Pollution (construction)	Changes to surface water levels/flows	Changes in salinity
Hen harrier	Stour and Orwell Estuaries SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Black-tailed godwit	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Dunlin	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Grey plover	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Pintail	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Redshank	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Ringed plover	Stour and Orwell Estuaries SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Shelduck	Stour and Orwell Estuaries SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Turnstone	Stour and Orwell Estuaries SPA	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Common redshank	Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Dark-bellied brent goose	Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Red knot	Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Waterfowl assemblage	Stour and Orwell Estuaries SPA Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
Nationally scarce plants (Criterion 2)	Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X
British Red Data Book invertebrates (Criterion 2)	Stour and Orwell Estuaries Ramsar	X ^m	X ^m	X ^m	X ^m	X ^m	X	X

6 NFN1 - Kings Lynn Desalination

6.1 Scheme Description

The King's Lynn Desalination Option is situated in Norfolk, south of King's Lynn and north of St Germans on the eastern bank of the River Great Ouse.

The option for King's Lynn is brackish water desalination, which will involve taking water from the River Great Ouse upstream of the proposed desalination plant and transferring it to the King's Lynn Desalination Plant.

The option involves abstraction of brackish tidal river water for three hours at each low tide to minimise salinity. This water will be stored in raw water balance tanks and delivered to the treatment works at a uniform flowrate.

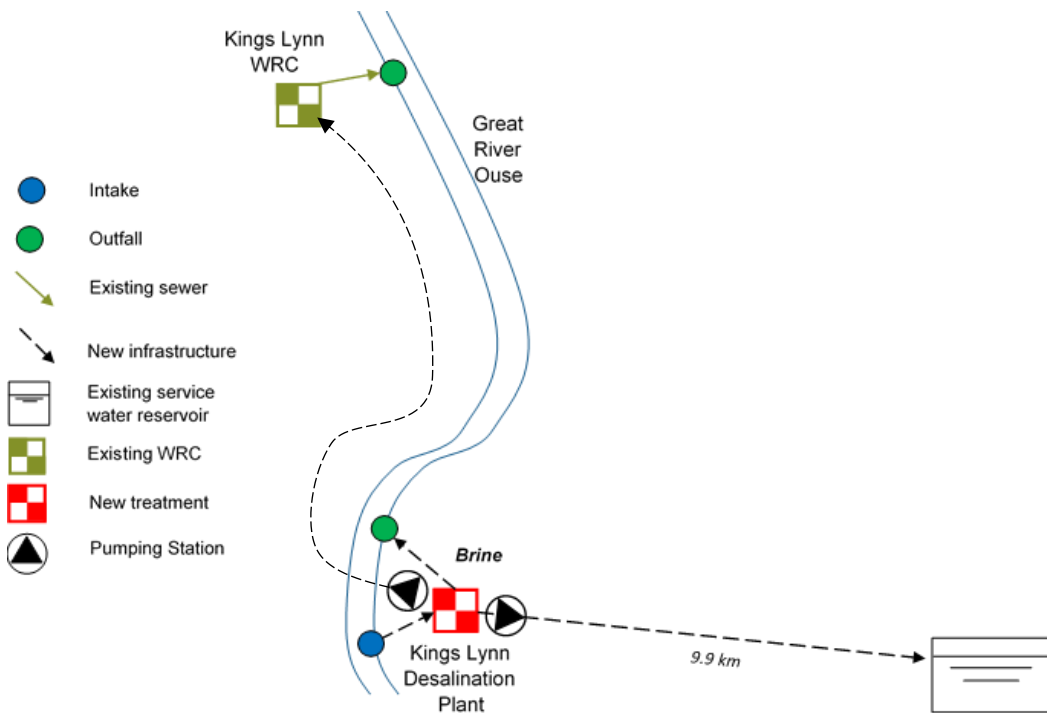
After the desalination process which also includes water treatment, the desalinated water will be pumped via a transfer pipeline 14km east to the existing Middleton Water Reservoir. The brine outfall from the King's Lynn Desalination Plant will be returned to the River Great Ouse via an outfall pipe, downstream of the intake pipe. Any additional waste streams will be pumped via transfer pipeline 9km north to the existing King's Lynn Sewage Works, which crosses the River Great Ouse at Saddlebow. The expected benefit is 11MI/d.

Construction for this option would include the King's Lynn Desalination Plant, the intake and outfall pipelines from the Desalination Plant and the transfer pipelines to Middleton Reservoir (existing) and King's Lynn Sewage Works (existing, including outfall to the River Great Ouse). The timescales for construction and commissioning of this option is two years (18 months construction, six months commissioning), therefore operation will begin after two years.

The desalination plant has been designed for continuous operations with alternative operating regimes such as standby mode under normal operation and full capacity operation during summer or periods of drought.

A schematic for this option is shown in Figure 5.

Figure 5: Kings Lynn Desalination Schematic



Source: Anglian Water (August 2018)

6.2 Designated Sites in the Zone of Influence

The following European sites have been identified as occurring within the Zol of the Kings Lynn desalination option:

- The Wash & North Norfolk Coast SAC;
- The Wash SPA and marine component (European Marine Site; EMS);
- The Wash Ramsar site.

The proposed location of the Kings Lynn desalination plant is south of King's Lynn and north of St Germans on the eastern bank of the River Great Ouse; approximately 10km downstream of The Wash. The intake of brackish water will be from the River Great Ouse and after desalination, brine will be discharged via an outfall pipe downstream of the intake. The River Great Ouse is one of the major contributors to the Wash.

After desalination, the treated water will be pumped via a new transfer pipeline 14km east to the existing Middleton Water Reservoir; this cross the River Great Ouse Relief Channel, approximately 10km downstream of the Wash.

Additional waste water from the desalination process will be pumped via a new transfer pipeline to the existing King's Lynn Sewage Works, located 1.5km from the Wash. The new transfer pipeline will cross the River Great Ouse at Saddlebow, approximately 7km downstream of the Wash.

The option is shown in relation to these European sites in Appendix B.

The European sites are described in Sections 5.2.1 to 5.2.6 below, along with their qualifying features, conservation objectives and vulnerabilities.

6.2.1 The Wash SPA and EMS

The Wash is the largest estuarine system in the UK. It is fed by the rivers Witham, Welland, Nene and Great Ouse that drain much of the east Midlands of England. It comprises very extensive saltmarshes, major intertidal banks of sand and mud, shallow waters and deep channels.

This SPA includes both marine areas and land not subject to tidal influences, with the marine part of the SPA termed a European Marine Site (The Wash and North Norfolk Coast EMS)⁷¹. The Wash and North Norfolk coast EMS is important for breeding and moulting of one of Europe's largest populations of common seal and the intertidal mudflats and salt marshes represent one of Britain's most important winter-feeding areas for waders and wildfowl outside of the breeding season.

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

Table 25: The Wash Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Common Tern <i>Sterna hirundo</i>	X		
Little Tern <i>Sterna albifrons</i>	X		
Marsh Harrier <i>Circus aeruginosus</i>	X		
Avocet <i>Recurvirostra avosetta</i>		X	
Bar-tailed Godwit <i>Limosa lapponica</i>		X	
Golden Plover <i>Pluvialis apricaria</i>		X	
Whooper Swan <i>Cygnus cygnus</i>		X	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Table 26: The Wash migratory species of international importance (SPA)

Article 4.2 interest feature	Breeding	Over winter	Passage
Ringed Plover <i>Charadrius hiaticula</i>			X
Sanderling <i>Calidris alba</i>			X
Black-tailed Godwit <i>Limosa limosa islandica</i>		X	
Curlew <i>Numenius arquata</i>		X	
Dark-bellied Brent Goose <i>Branta bernicla bernicla</i>		X	
Dunlin <i>Calidris alpina alpina</i>		X	
Grey Plover <i>Pluvialis squatarola</i>		X	
Knot <i>Calidris canutus</i>		X	

⁷¹ English Nature (2000) Wash and North Norfolk Coast European marine site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Issued 14 June 2000

Article 4.2 interest feature	Breeding	Over winter	Passage
Oystercatcher <i>Haematopus ostralegus</i>		X	
Pink-footed Goose <i>Anser brachyrhynchus</i>		X	
Pintail <i>Anas acuta</i>		X	
Redshank <i>Tringa totanus</i>		X	
Shelduck <i>Tadorna tadorna</i>		X	
Turnstone <i>Arenaria interpres</i>		X	
Over winter, the area regularly supports 400,273 individual waterfowl (5 year peak mean 1991/2 - 1995/6)	Black-tailed Godwit, Avocet, Golden Plover, Bar-tailed Godwit, Pink-footed Goose, Dark-bellied Brent Goose, Shelduck, Pintail, Oystercatcher, Grey Plover, Whooper Swan, Dunlin, Sanderling, Curlew, Redshank, Turnstone, Little Grebe, Cormorant, White-fronted Goose, Wigeon, Mallard, Ringed Plover, Lapwing, Knot, Whimbrel.		

The salt-marshes support a diverse breeding bird population, including over 4,000 pairs of black-headed gulls (2%), shelducks and numerous wader species. Breeding redshanks occur at exceptionally high densities, and the breeding population of this species is of national importance.

6.2.2 The Wash Ramsar site

The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels. It provides habitats for an important assemblage of wetland birds in the non-breeding season and supports internationally important numbers of wintering and passage wildfowl and waders.

Table 27: 2.2.3 The Wash Ramsar site⁷²

Criterion	Qualifying Features of the Ramsar site	Notes
1	Contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.
3	Supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.
5	Regularly supports 20,000 or more waterbirds	Species with peak counts in winter: 292541 waterfowl (5-year peak mean 1998/99-2002/2003)
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Species with peak counts in spring/autumn: Eurasian oystercatcher, grey plover, red knot, sanderling, Eurasian curlew, common redshank, ruddy turnstone. Species with peak counts in winter: Pink-footed goose, dark-bellied brent goose, common shelduck, northern pintail, dunlin, bar-tailed godwit

Source: JNCC, 2008

⁷² JNCC (2008). Ramsar Information Sheet: UK11072. The Wash. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11072.pdf>

6.2.3 The Wash & North Norfolk Coast SAC

The Wash & North Norfolk Coast SAC is located on the east coast of England and is designated as an SAC under Article 3 of the EC Habitats Directive (92/43/EEC). It includes marine areas, sea inlets, tidal rivers, estuaries, mud flats, sand flats, lagoons (including saltwork basins), salt marshes, salt pastures and salt steppes. The primary qualifying features (Annex 1 habitat types and Annex II species) of the Wash & North Norfolk Coast SAC are presented in Table 28.

Table 28: Qualifying features of The Wash & North Norfolk Coast SAC

Qualifying feature	Description
Annex I Habitat	
Sandbanks	This SAC has one of the largest expanses of sublittoral sandbanks in the UK. The subtidal sandbanks vary in composition and include coarse sand through to mixed sediment at the mouth of the embayment. This habitat type provides important nursery grounds for young commercial fish species, including plaice <i>Pleuronectes platessa</i> , cod <i>Gadus morhua</i> and sole <i>Solea solea</i> .
Mudflats/ sandflats	This SAC is the second-largest area of intertidal flats in the UK. The sandflats in the embayment of the Wash include extensive fine sands and drying banks of coarse sand, and this diversity of substrates, coupled with variety in degree of exposure, means that there is a high diversity relative to other east coast sites. The biota includes large numbers of polychaetes, bivalves and crustaceans. Salinity ranges from that of the open coast in most of the area (supporting rich invertebrate communities) to estuarine close to the rivers.
Large shallow inlets and bays	The Wash is the largest embayment in the UK and represents large shallow inlets and bays on the east coast of England. It is connected via sediment transfer systems to the north Norfolk coast. Communities in the intertidal include those characterised by large numbers of polychaetes, bivalve and crustaceans. Sublittoral communities cover a diverse range from the shallow to the deeper parts of the embayments and include dense brittlestar beds and areas of an abundant reef-building worm <i>Sabellaria spinulosa</i> . The embayment supports a variety of mobile species, including a range of fish and 1365 Common seal <i>Phoca vitulina</i> .
Reefs	The relatively common tube-dwelling polychaete worm <i>Sabellaria spinulosa</i> forms areas of biogenic reef within the SAC. These structures are varied in nature and can include reefs which stand up to 30 cm proud of the seabed and which extend for hundreds of meters. The reefs are particularly important components of the sublittoral as they are diverse and productive habitats which support many associated species (including epibenthos and crevice fauna) that would not otherwise be found in predominantly sedimentary areas. Associated mobile species include large numbers of polychaetes, mysid shrimps, the pink shrimp <i>Pandalus montagui</i> , and crabs. <i>S. spinulosa</i> is considered to be an important food source for the commercially important pink shrimp <i>P. montagui</i> .
Salicornia and other annuals colonizing mud and sand	The largest single area of this vegetation in the UK occurs at this site on the east coast of England, which is one of the few areas in the UK where saltmarshes are generally accreting. The proportion of the total saltmarsh vegetation represented by Salicornia and other annuals colonising mud and sand is high because of the extensive enclosure of marsh in this site. The vegetation is also unusual in that it forms a pioneer community with common cord-grass <i>Spartina anglica</i> in which it is an equal component.
Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>)	The Wash saltmarshes represent the largest single area of the habitat type in the UK. Saltmarsh swards dominated by sea-lavenders <i>Limonium</i> spp. are particularly well-represented on this site. In addition to typical lower and middle saltmarsh communities, in North Norfolk there are transitions from upper marsh to freshwater reedswamp, sand dunes, shingle beaches and mud/sandflats.
Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)	The Wash and North Norfolk Coast, together with the North Norfolk Coast, comprises the only area in the UK where all the more typically Mediterranean species that characterise Mediterranean and thermo-Atlantic halophilous scrubs occur together. This scrub vegetation often forms an important feature of the upper saltmarshes, and extensive examples occur where the drift-line slopes gradually and provides a transition to dune, shingle or reclaimed sections of the coast.
Annex II Species	
Harbour seal <i>Phoca vitulina</i>	The Wash, on the east coast of England, is the largest embayment in the UK. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for

Qualifying feature	Description
Source: JNCC (2018) ⁷³	Harbour seal <i>Phoca vitulina</i> breeding and hauling-out. This site is the largest colony of common seals in the UK, with some 7% of the total UK population.

Habitats/ species present as a qualifying feature of the SAC, but not a primary reason for selection have also been identified within the European site. These features are:

- Annex I Habitat: Coastal Lagoons
- Annex II Species: Otter *Lutra lutra*

6.2.4 Conservation objectives of The Wash⁷⁴

The conservation objectives of The Wash are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

6.2.5 Vulnerability of The Wash

The main threats to The Wash and North Norfolk Coast are impacts from fisheries, public access and siltation. The key issues identified in the Site Improvement Plan for the SPA⁷⁵ are:

- Structures that control water levels in disrepair, preventing appropriate water level controls for breeding birds.
- Public access and disturbance from a range of air, land- and water-based activities causing disturbance impacts on waterbirds.
- Sediment accretion.
- Recreational marine and estuarine fisheries impacting fish stocks as a resource for designated birds.
- Risk of introduction and spread of invasive/ non-native species (e.g. American razor clam *Ensis directus*; slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite *Bonamia*) from future fisheries and mussel lay stocking. Also risk of translocation through ballast water.
- Inappropriate coastal management, through conflicts between flood risk management and the protection and provision of the European sites.
- Pressures and threats from commercial marine and estuarine fisheries and uncertainty of current management.
- Lack of predator control.

⁷³ JNCC (2018). The Wash and North Norfolk Coast. <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?euocode=UK0017075>

⁷⁴ Natural England (2014). European Site Conservation Objectives for The Wash Special Protection Area Site Code: Version 2, 3/062014 UK9008021 Available at: <http://publications.naturalengland.org.uk/publication/5747661105790976>

⁷⁵ Natural England (2015). Site Improvement Plan – The Wash & Norfolk Coast. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

- Coastal squeeze causing loss and degradation of habitats due to the presence of coastal defences and sea level rise.
- Change in land management through under and over-grazing.
- Air pollution impacts, with the level of nitrogen deposition currently exceeding site-relevant critical loads.
- Changes in species distribution.

6.2.6 Qualifying habitats of the Wash SPA/Ramsar site/SAC in the Zone of Influence

There are 60 units within the Wash SSSI, the majority of which are in hydrological continuity with the Great River Ouse and all of which are littoral sediment. Littoral sediment includes shingle, gravel, sand and mud habitats, or a combination of these, which occur in the intertidal zone. These fall under saltmarsh habitat and are estuarine habitats, confirming the presence of habitat qualifying under Criterion 1 of the Wash Ramsar site.

Based on the habitat descriptions included in the European site citations summarised above and the component parts of the option, it is considered that the habitat features at risk from the implementation of the option are the intertidal mudflats and sandflats, sensitive to changes in the water table, sediment transport and water quality.

6.2.7 Qualifying bird species of The Wash SPA/Ramsar site/SAC in the Zone of Influence

All the qualifying bird species of The Wash SPA and Ramsar site have either been recorded during condition assessment surveys or have the potential to be supported by the habitats present in the ZoI. All the following species are therefore screened in to this Appropriate Assessment:

- Common Tern
- Little Tern
- Marsh Harrier
- Avocet
- Bar-tailed Godwit
- Golden Plover
- Whooper Swan
- Ringed Plover
- Sanderling
- Black-tailed Godwit
- Curlew
- Dark-bellied Brent Goose
- Dunlin
- Grey Plover
- Knot
- Oystercatcher
- Pink-footed Goose
- Pintail
- Redshank
- Shelduck

- Turnstone

6.3 Potential Impacts of NFN1 Kings Lynn Desalination

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UK WIP guidance (Table 2). The proposed location of the desalination plant, intake and outfall points and all associated pipelines are at a distance far enough beyond the boundaries of the European site (at least 10km), that no impacts from disturbance (noise/visual/light) or physical damage (habitat loss or degradation) through construction are anticipated. The closest location for the construction of the new transfer pipelines is 1.5km for the Wash, similarly no impacts from disturbance (noise/visual/light) or physical damage (habitat loss or degradation) through construction are anticipated.

There is uncertainty with regards to whether the infrastructure related to the implementation of the Plan would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size and scale of the proposed Kings Lynn desalination option, the impacts with the potential to result in adverse effects are:

Construction Impacts

- Toxic contamination
 - Water pollution;
 - Air pollution.
- Physical damage
 - Habitat degradation.
- Biological disturbances
 - Changes to habitat availability.

Operational Impacts

- Water table / availability
 - Changes to surface water levels and flows.
- Non-toxic contamination
 - Changes in salinity.
- Physical damage
 - Habitat degradation.
- Biological disturbances
 - Changes to habitat availability.

Details of each of the potential adverse effect are given below, with the sensitivity of the qualifying species of the European sites considered. An assessment of how the impact might affect the integrity of the sites is made, in view of the sites' structure, function and conservation objectives. Where adverse impacts are deemed significant, mitigation measures are proposed in Section 6.5.

6.3.1 Construction impacts

6.3.1.1 Toxic contamination

Water Pollution

During the construction period, works will be required within and in the vicinity of the River Great Ouse, particularly where the new transfer pipelines crosses the main river at Saddlebow, the Relief Channel east of St German's and for the construction of the proposed intake and outfall pipelines at the new desalination plant.

If a water pollution incident should occur, there is potential for adverse effects on water quality in the River Great Ouse, introducing a pathway to reduced water quality entering the European site. Increased sedimentation may also occur through the movement of heavy plant vehicles adjacent to the river and in-river works. Sediment accretion has already been identified as a pressure in the Wash SPA and SAC Site Improvement Plan's, with any pollution impacts from the option therefore having the potential to exacerbate this.

If a water pollution incident should occur, a pathway exists to impact the European sites and may cause adverse effects on the qualifying habitat features, with potential knock-on impacts on the qualifying bird and mammal species. Anglian Water have ensured however, that directional drilling will be employed as a construction technique to avoid any in-channel works, thus avoiding any potential impacts on water quality during construction. Therefore, impacts as a result of water pollution during construction of the pipelines are not considered likely.

For the construction of the intake and outfall, there is a risk of discrete pollution events resulting in water pollution. Given the tidal nature of the upstream portion of the River Great Ouse, it is assumed that any contaminants will be flushed and diluted quickly, however this impact cannot be scoped out and will require consideration through appropriate mitigation.

It is also possible that impacts on water pollution could have an indirect, knock-on effect on the physical habitat of the European sites, resulting in habitat degradation, which could in turn impact habitat availability and thus impact biological communities within the sites.

Air Pollution

Air pollution can result from the release of particulate matter (dust) into the atmosphere or through exhaust emissions from vehicles. Construction activities associated with the scheme are likely to involve dust generating activities during the construction phase, thereby potentially increasing air pollution in the area. While the distance at which significant effects are likely to occur is dependent on the extent and nature of mitigation measures, prevailing wind direction, and rainfall, effects from construction activities that generate dust are generally limited to within 150-200m⁷⁶.

The distance of the proposed desalination plant and pipelines from the European sites (>1.5 km), and the unlikelihood that air pollution will cause any significant adverse effects on water quality at river crossings means that impacts as a result of air pollution from dust are not considered likely. This effect is therefore scoped out from further assessment.

Toxic Contamination: Adverse Effects on Site Integrity

The interest features of the European sites which may experience adverse effects through water pollution are:

⁷⁶ Highways Agency 2007, Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, HA207/07 (Air Quality). Available at: <<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20707.pdf>> [Accessed 22 November 2017].

- The Wash SPA
 - Breeding and overwintering bird populations of European importance (common tern, little tern, marsh harrier, avocet, bar-tailed godwit, golden plover, whooper swan, ringed plover, curlew, dark-bellied goose, dunlin, grey plover, knot, oystercatcher, pink-footed goose, pintail, redshank, shelduck, turnstone and waterfowl): these species use intertidal and estuarine habitat for breeding feeding or loafing – these habitats are sensitive to pollution impacts.
- The Wash Ramsar site
 - Ramsar Criterion 1 (extensive saltmarshes, major intertidal banks of sand and mud, shall water and deep channels)
 - Ramsar Criterion 3 (inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters)
 - Ramsar Criterion 5 (the supporting habitat of waterbirds may be sensitive to reduced water quality entering the Wash)
 - Ramsar Criterion 6 (the supporting habitat of waterbirds may be sensitive to reduced water quality entering the Wash)
- The Wash & Norfolk Coast SAC
 - Sandbanks which are slightly covered by seawater all the time
 - Mudflats and sandflats not covered by seawater at low tide
 - Annex II species Harbour seal

6.3.2 Operation impacts

6.3.2.1 Water Table/ Availability

Changes to surface water levels and flows

Although the direct water intake is not located within a European site, it is located within the River Great Ouse, which is one of the major contributors to the Wash. Changes to flows into The Wash are likely to affect habitats that support qualifying bird species, resulting in potential significant effects. A reduction in flows could also increase the amount of sediment accretion, which is a key issue already identified for the Wash.

However, considering the distance of the intake and outfall points from the European sites (approximately 11 km); the natural fluctuation in water levels of these intertidal sites; and the likelihood that overall flows will be balanced between intake and outfall, it is considered that this effect will not result in a significant adverse impact on the qualifying habitats and species of the European sites.

Water table / availability: adverse effects on European sites

Given the tidal nature of the Wash estuary, freshwater input is only a minor contributor to levels and flows in the Wash. Consequently, no significant adverse effects from changes to surface water levels and flows are foreseeable on any of the qualifying features of the European sites.

6.3.2.2 Non-toxic contamination

Changes in salinity

The proposed Kings Lynn desalination option includes an outfall point within the River Great Ouse for the discharge of brine produced through the reverse osmosis process used in

desalination. Depending on the concentration and volume to be discharged, brine may affect the salinity and temperature of water.

The Wash is hydrologically linked to the outfall point with a potential pathway for impact therefore existing. Salinity is an essential functional component of estuaries, with the salinity gradient determining the species which live along it. The boundary of the Wash is approximately 10 km downstream of the proposed outfall, suggesting that impacts could be reduced through dilution with freshwater flows in the Great Ouse and changes in salinity or temperature are likely to be significantly decreased. However, in the absence of detailed modelling results, this effect is precautionarily scoped in for assessment.

It is also possible that changes in salinity could have an indirect, knock-on effect on the physical habitat of the European sites, resulting in habitat degradation, which could in turn impact habitat availability and thus impact biological communities within the sites.

Non-toxic contamination: adverse effects on European sites

The interest features of the European sites which may experience adverse effects through non-toxic contamination are:

- The Wash SPA
 - The intertidal flats have a rich invertebrate fauna and colonising beds of *Glasswort Salicornia* spp. which are important food sources for the large numbers of waterbirds dependent on the site. A change in salinity may change the composition of these invertebrate communities.
- The Wash Ramsar
 - Ramsar Criterion 1 (vegetation associated with estuarine habitats has the potential to be impacted by changes in salinity levels).
 - Ramsar Criterion 3 (the inter-relationship between various estuarine components may be impacted by a change in salinity levels)
- The Wash & Norfolk Coast SAC
 - Estuaries (vegetation associated with estuarine habitats has the potential to be impacted by changes in salinity levels).

6.4 Summary of Potential Impacts of the Option

The assessment of potential impacts of the Kings Lynn desalination option given in Section 6.3 has identified the potential impacts that are considered likely to result in adverse effects on the conservation objectives and qualifying features of European sites. These are summarised in Table 29.

Table 29: Summary of potential adverse effects of NFN 1 Kings Lynn Desalination option on European sites

European Site	Potential Adverse Impact	Sensitive Interest Feature	Permanent or Temporary
The Wash SPA	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Breeding and overwintering bird populations	Temporary during construction only
	Non-toxic contamination (specifically changes in salinity) through the discharge of brine during	Breeding and overwintering bird populations	Permanent during periods of operation of the desalination plant

European Site	Potential Adverse Impact	Sensitive Interest Feature	Permanent or Temporary
	operation of desalination at Kings Lynn		
The Wash Ramsar site	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Ramsar Criterion 1 (extensive saltmarshes, major intertidal banks of sand and mud, shall water and deep channels) Ramsar Criterion 3 (inter-relationship between its various components) Ramsar Criterion 5 (supporting habitat of waterbirds) Ramsar Criterion 6 (supporting habitat of waterbirds)	Temporary during construction only
	Non-toxic contamination (specifically changes in salinity) through discharge of brine during operation of desalination at Kings Lynn	Ramsar Criterion 1 (vegetation associated with estuarine habitats). Ramsar Criterion 3 (the inter-relationship between various estuarine components)	Permanent during periods of operation of the desalination plant
The Wash & Norfolk Coast SAC	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Estuarine habitats Harbour seal	Temporary during construction only
	Non-toxic contamination (specifically changes in salinity) through discharge of brine during operation of desalination at Kings Lynn	Estuarine habitats Harbour seal	Permanent during periods of operation of the desalination plant

6.5 Conclusions and Recommendations

6.5.1 Background

The option involves abstraction of brackish tidal river water from the River Great Ouse, which will undergo the desalination process. The water will be pumped via a transfer pipeline 14km east to the existing Middleton Water Reservoir. The brine outfall from the King's Lynn desalination plant will be returned to the River Great Ouse via an outfall pipe, downstream of the intake pipe. Any additional waste streams will be pumped via transfer pipeline 9km north to the existing King's Lynn Sewage Works, which crosses the River Great Ouse at Saddlebow.

Construction for this option would include the King's Lynn desalination plant, the intake and outfall pipelines from the Desalination Plant and the transfer pipelines to Middleton Reservoir (existing) and King's Lynn Sewage Works (existing, including outfall to the River Great Ouse).

The timescales for construction and commissioning of this option is two years (18 months construction, six months commissioning), therefore operation will begin after two years.

6.5.2 Summary of Potential Effects on European Sites

A HRA Task II: Appropriate Assessment considered the impact of a plan on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its structure and function. The Task II assessment can be addressed in answer to the following:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed WRMP option is not within the boundary of a European site.

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as being in hydrological continuity with the proposed WRMP option:

- The Wash SPA;
- The Wash Ramsar site;
- The Wash & Norfolk Coast SAC.

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s), either directly or indirectly?

The assessment has identified there is a likelihood for adverse effects on the Wash SPA/Ramsar site/SAC during the construction and operation of the option. Construction impacts relate to pollution events resulting in potential adverse effects on water quality. Operational impacts relate to non-toxic contamination due to changes in salinity as a result of brine discharge.

6.5.3 Proposed Mitigation Measures

It is reasonably assumed that the impacts identified during construction (i.e. the potential for pollution events to result in adverse effects in water quality during the construction of the new intake and outfall pipelines) can be mitigated through the following measures, considered good practice, for the prevention of pollution during construction and thus appropriate to be incorporated in to the methodology of this option. It is considered, on the basis of the available information, that the option is unlikely to result in adverse effects on the integrity of the European sites or their interest features during construction if such mitigation is employed:

- Water pollution:
 - Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW).⁷⁷

For impacts identified during operation of the option which relate to the discharge of brine, the extent to which the qualifying features of the European sites are affected cannot be determined at this stage. Further investigation and detail as to the volume and concentration of brine released will be required, which will potentially be supported by a field study and design-specific impact assessment. Anglian Water is committed to mitigation, and it is assumed that after further investigation at the project-level HRA, and with the application of mitigation such as is proposed below, that the option will only be implemented with the assurance that no residual effects are likely.

- Potential mitigation for changes to salinity:

⁷⁷ GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in GPP 5: Works and maintenance in or near water (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

- The significance of change to salinity levels will depend on the concentration and volume of brine discharge at the proposed outfall point. Determining a set target for salinity is complex due to the dynamic nature of the marine environment. However, as per guidance on Common Standards Monitoring Guidance for Estuaries⁷⁸, readings should not deviate from the salinity range predicted for the site by the baseline data. Following these guidelines and suggested techniques should mitigate the risk of significant adverse effects from changes in salinity levels on the qualifying features of the European sites.

6.5.4 Summary of the Task II: Appropriate Assessment

For the impacts identified during construction, it is suggested that with appropriate mitigation, no significant adverse effects are reasonably foreseeable on the integrity of European sites as a result of construction.

For the impacts identified during operation (i.e. potential increased as a result of brine discharge), the effects of this impact will need to be explored further in order to demonstrate that the integrity of European sites will not be significantly adversely affected. Anglian Water is committed to putting in a suitable mitigation strategy following investigation at the project-level HRA to ensure there are no residual effects on the integrity of the European sites.

The overall likelihood of adverse impacts of NFN1 Kings Lynn desalination option on the qualifying features of the Wash European site are summarised in Table 30.

Table 30: Assessment of potential adverse impacts of Kings Lynn desalination on the European qualifying features within the ZoI (X = adverse impact can be excluded; X^m= adverse impact is likely to be excluded following appropriate mitigation measures; X^p=adverse impact likely to be excluded following further investigation at project-level)

		Potential impacts of SHB1 South Humber Bank Desalination								
Qualifying feature	European sites	Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and	Change in salinity	Direct mortality
Sandbanks which are slightly covered by sea water all the time	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Mudflats and sandflats not covered by seawater at low tide	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Large shallow inlets and bays	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Reefs	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Salicornia and other annuals colonising mud and sand	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Atlantic salt meadows	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X

⁷⁸ JNCC (2004). Common Standards Monitoring Guidance for Estuaries

Potential impacts of SHB1 South Humber Bank Desalination

Qualifying feature	European sites	Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and	Change in salinity	Direct mortality
Mediterranean and thermos-atlantic halophilous scubs	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Costal lagoons	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Harbour seals	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Otter	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X ^p	X
Common Tern	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Little Tern	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Marsh Harrier	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Avocet	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Bar-tailed Godwit	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Golden Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Whooper Swan	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Ringed Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Sanderling	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Black-tailed Godwit	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Curlew	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Dark-bellied Brent Goose	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Dunlin	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Grey Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Knot	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Oystercatcher	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Pink-footed Goose	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Pintail	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Redshank	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Shelduck	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Turnstone	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Assemblage of waterfowl	The Wash SPA	X	X	X	X	X ^m	X	X	X ^p	X
Ramsar Criterion 1	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X ^p	X
Ramsar Criterion 3	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X ^p	X
Ramsar Criterion 5	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X ^p	X
Ramsar Criterion 6	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X ^p	X

7 NFN2 - Kings Lynn Water Reuse

7.1 Option Description

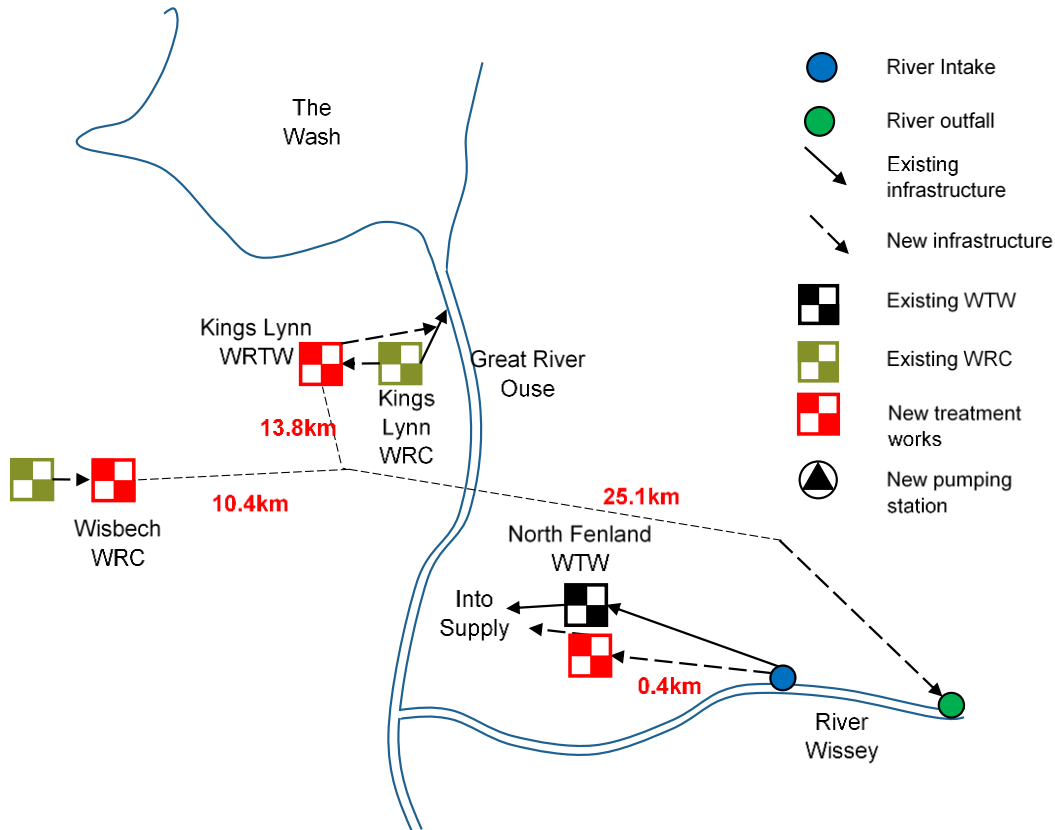
Sub-option A of the King's Lynn Water Reuse option includes the construction of a new WRTW adjacent to the existing Kings Lynn WRC, with a new pipeline between the two. The water treated at this new WRTW will be conveyed to a new outfall along the River Wissey via a new 29km transfer pipeline. The treated flow will then be abstracted downstream on the River Wissey (at a new abstraction point) to Stoke Ferry WTW for treatment prior to entering the potable water network. The option also includes an increase of capacity at Stoke Ferry WTW (through a new WTW) and a new pipeline from the River Wissey to the new WTW, see Figure 6.

The pipeline between Kings Lynn WRC and the new WRTW has no specific route as its expected length is under 2km, it has therefore been assumed that this pipeline is in a straight line between the two assets. Similarly, the new pipeline from the intake along the River Wissey to new Stoke Ferry WTW has also been assumed as a straight-line due to it being less than 2km in length.

Sub-option B of the King's Lynn Water Reuse option does not involve the new WTW at Stoke Ferry or the associated pipeline, or the new intake from the River Wissey. All other option elements are included.

It is assumed that the construction and commissioning phase of the option will last two years (18 months for construction and six months for commissioning), the equivalent of the short-term significance of the effect.

Figure 6 King's Lynn Water Reuse Option Schematic



Source: Anglian Water (August 2018)

7.2 Designated Sites in the Zone of Influence

The following European sites have been identified as occurring within the 5km Zol around Kings Lynn water reuse option:

- The Wash SPA;
- The Wash Ramsar site;
- The Wash & North Norfolk Coast SAC;
- Norfolk Valley Fens SAC;
- Breckland SPA.

The proposed location of the new Kings Lynn WRTW is North-West of King's Lynn on the left (western) bank of the River Great Ouse; approximately 1.5 km upstream of The Wash. Treated water will be transferred via a new transfer pipeline from the new Kings Lynn WRTW to an outfall on the River Wissey at Stoke Ferry. This new transfer pipeline crosses the River Great Ouse over 15km upstream of the Wash. The new WTW proposed in sub-option A to increase capacity at Stoke Ferry is located on the northern bank of the River Wissey, approximately 20 km south of Kings Lynn. The River Wissey flows into the River Great Ouse, which is one of the major contributors to the Wash.

The proposed outfall location for treated water from Kings Lynn WRC is into the River Wissey, approximately 2.7km from the Norfolk Valley Fens and 4.2 km from Breckland. As these sites are located upstream of the outfall location and are not directly fed by the river, this option does not have any foreseeable significant impacts on the qualifying features of these sites. Thus, these sites have been scoped out from further assessment.

The European sites scoped in to the assessment are described in Sections 7.2.1 to 7.2.7 below. They are The Wash SPA/Ramsar site and The Wash & North Norfolk Coast SAC. The option is shown in relation to these European sites in Appendix B.

7.2.1 The Wash SPA and marine component

The Wash is the largest estuarine system in the UK. It is fed by the rivers Witham, Welland, Nene and Great Ouse that drain much of the east Midlands of England. It comprises very extensive saltmarshes, major intertidal banks of sand and mud, shallow waters and deep channels.

This SPA includes both marine areas and land not subject to tidal influences, with the marine part of the SPA termed a European Marine Site (The Wash and North Norfolk Coast EMS)⁷⁹. The Wash and North Norfolk coast EMS is important for breeding and moulting of one of Europe's largest populations of common seal *and* the intertidal mudflats and salt marshes represent one of Britain's most important winter-feeding areas for waders and wildfowl outside of the breeding season.

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

Table 31: The Wash Annex 1 species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Common Tern <i>Sterna hirundo</i>	X		
Little Tern <i>Sterna albifrons</i>	X		
Marsh Harrier <i>Circus aeruginosus</i>	X		
Avocet <i>Recurvirostra avosetta</i>		X	
Bar-tailed Godwit <i>Limosa lapponica</i>		X	
Golden Plover <i>Pluvialis apricaria</i>		X	
Whooper Swan <i>Cygnus cygnus</i>		X	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Table 32: The Wash migratory species of international importance (SPA)

Article 4.2 interest feature	Breeding	Over winter	Passage
Ringed Plover <i>Charadrius hiaticula</i>			X
Sanderling <i>Calidris alba</i>			X
Black-tailed Godwit <i>Limosa limosa islandica</i>		X	
Curlew <i>Numenius arquata</i>		X	

⁷⁹ English Nature (2000) Wash and North Norfolk Coast European marine site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Issued 14 June 2000

Article 4.2 interest feature	Breeding	Over winter	Passage
Dark-bellied Brent Goose <i>Branta bernicla bernicla</i>		X	
Dunlin <i>Calidris alpina alpina</i>		X	
Grey Plover <i>Pluvialis squatarola</i>		X	
Knot <i>Calidris canutus</i>		X	
Oystercatcher <i>Haematopus ostralegus</i>		X	
Pink-footed Goose <i>Anser brachyrhynchus</i>		X	
Pintail <i>Anas acuta</i>		X	
Redshank <i>Tringa totanus</i>		X	
Shelduck <i>Tadorna tadorna</i>		X	
Turnstone <i>Arenaria interpres</i>		X	
Over winter, the area regularly supports 400,273 individual waterfowl (5-year peak mean 1991/2 - 1995/6)	Black-tailed Godwit, Avocet, Golden Plover, Bar-tailed Godwit, Pink-footed Goose, Dark-bellied Brent Goose, Shelduck, Pintail, Oystercatcher, Grey Plover, Whooper Swan, Dunlin, Sanderling, Curlew, Redshank, Turnstone, Little Grebe, Cormorant, White-fronted Goose, Wigeon, Mallard, Ringed Plover, Lapwing, Knot, Whimbrel.		

The salt-marshes support a diverse breeding bird population, including over 4,000 pairs of black-headed gulls (2%), shelducks and numerous wader species. Breeding redshanks occur at exceptionally high densities, and the breeding population of this species is of national importance.

7.2.2 The Wash Ramsar site

The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels. It provides habitats for an important assemblage of wetland birds in the non-breeding season and supports internationally important numbers of wintering and passage wildfowl and waders.

Table 33: 2.2.3 The Wash Ramsar site

Criterion	Qualifying Features of the Ramsar site	Notes
1	Contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.
3	Supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.
5	Regularly supports 20,000 or more waterbirds	Species with peak counts in winter: 292541 waterfowl (5-year peak mean 1998/99-2002/2003)
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Species with peak counts in spring/autumn: Eurasian oystercatcher, grey plover, red knot, sanderling, Eurasian curlew, common redshank, ruddy turnstone. Species with peak counts in winter: Pink-footed goose, dark-bellied brent goose, common shelduck, northern pintail, dunlin, bar-tailed godwit

Source: JNCC, 2008⁸⁰

7.2.3 The Wash & North Norfolk Coast SAC

The Wash & North Norfolk Coast SAC is located on the east coast of England and is designated as an SAC under Article 3 of the EC Habitats Directive (92/43/EEC). It includes marine areas, sea inlets, tidal rivers, estuaries, mud flats, sand flats, lagoons (including saltwork basins), salt marshes, salt pastures and salt steppes. The primary qualifying features (Annex 1 habitat types and Annex II species) of the Wash & North Norfolk Coast SAC are presented in the table below:

Table 34: Qualifying features of The Wash & North Norfolk Coast SAC

Qualifying feature	Description
Annex I Habitat	
Sandbanks	This SAC has one of the largest expanses of sublittoral sandbanks in the UK. The subtidal sandbanks vary in composition and include coarse sand through to mixed sediment at the mouth of the embayment. This habitat type provides important nursery grounds for young commercial fish species, including plaice <i>Pleuronectes platessa</i> , cod <i>Gadus morhua</i> and sole <i>Solea solea</i> .
Mudflats/ sandflats	This SAC is the second-largest area of intertidal flats in the UK. The sandflats in the embayment of the Wash include extensive fine sands and drying banks of coarse sand, and this diversity of substrates, coupled with variety in degree of exposure, means that there is a high diversity relative to other east coast sites. The biota includes large numbers of polychaetes, bivalves and crustaceans. Salinity ranges from that of the open coast in most of the area (supporting rich invertebrate communities) to estuarine close to the rivers.
Large shallow inlets and bays	The Wash is the largest embayment in the UK and represents large shallow inlets and bays on the east coast of England. It is connected via sediment transfer systems to the north Norfolk coast. Communities in the intertidal include those characterised by large numbers of polychaetes, bivalve and crustaceans. Sublittoral communities cover a diverse range from the shallow to the deeper parts of the embayments and include dense brittlestar beds and areas of an abundant reef-building worm <i>Sabellaria spinulosa</i> . The embayment supports a variety of mobile species, including a range of fish and 1365 Common seal <i>Phoca vitulina</i> .
Reefs	The relatively common tube-dwelling polychaete worm <i>Sabellaria spinulosa</i> forms areas of biogenic reef within the SAC. These structures are varied in nature and can include reefs which stand up to 30 cm proud of the seabed and which extend for hundreds of meters. The reefs are particularly important components of the sublittoral as they are diverse and productive habitats which support many associated species (including epibenthos and crevice fauna) that would not otherwise be found in predominantly sedimentary areas. Associated mobile species include large numbers of polychaetes, mysid shrimps, the pink shrimp <i>Pandalus montagui</i> , and crabs. <i>S. spinulosa</i> is considered to be an important food source for the commercially important pink shrimp <i>P. montagui</i> .
Salicornia and other annuals colonizing mud and sand	The largest single area of this vegetation in the UK occurs at this site on the east coast of England, which is one of the few areas in the UK where saltmarshes are generally accreting. The proportion of the total saltmarsh vegetation represented by Salicornia and other annuals colonising mud and sand is high because of the extensive enclosure of marsh in this site. The vegetation is also unusual in that it forms a pioneer community with common cord-grass <i>Spartina anglica</i> in which it is an equal component.
Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)	The Wash saltmarshes represent the largest single area of the habitat type in the UK. Saltmarsh swards dominated by sea-lavenders <i>Limonium</i> spp. are particularly well-represented on this site. In addition to typical lower and middle saltmarsh communities, in North Norfolk there are transitions from upper marsh to freshwater reedswamp, sand dunes, shingle beaches and mud/sandflats.
Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)	The Wash and North Norfolk Coast, together with the North Norfolk Coast, comprises the only area in the UK where all the more typically Mediterranean species that characterise Mediterranean and thermo-Atlantic halophilous scrubs occur together. This scrub vegetation often forms an important feature of the upper saltmarshes, and extensive

⁸⁰ JNCC (2008). Ramsar Information Sheet: UK11072. The Wash. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11072.pdf>

Qualifying feature	Description
	examples occur where the drift-line slopes gradually and provides a transition to dune, shingle or reclaimed sections of the coast.
Annex II Species	
Harbour seal <i>Phoca vitulina</i>	The Wash, on the east coast of England, is the largest embayment in the UK. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for Harbour seal breeding and hauling-out. This site is the largest colony of common seals in the UK, with some 7% of the total UK population.

Source: JNCC (2018)⁸¹

Habitats/ species present as a qualifying feature of the SAC, but not a primary reason for selection have also been identified within the European site. These features are:

- Annex I Habitat: Coastal Lagoons
- Annex II Species: Otter *Lutra lutra*

7.2.4 Conservation Objectives of The Wash

The conservation objectives of The Wash⁸² are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

7.2.5 Vulnerability of The Wash

The main threats to The Wash and North Norfolk Coast are impacts from fisheries, public access and siltation. The key issues identified in the Site Improvement Plan for the SPA⁸³ are:

- Structures that control water levels in disrepair, preventing appropriate water level controls for breeding birds.
- Public access and disturbance from a range of air, land- and water-based activities causing disturbance impacts on waterbirds.
- Sediment accretion.
- Recreational marine and estuarine fisheries impacting fish stocks as a resource for designated birds.
- Risk of introduction and spread of invasive/ non-native species (e.g. American razor clam *Ensis directus*; slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite *Bonamia*) from future fisheries and mussel lay stocking. Also risk of translocation through ballast water.
- Inappropriate coastal management, through conflicts between flood risk management and the protection and provision of the European sites.

⁸¹ JNCC (2018). The Wash and North Norfolk Coast. <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?euocode=UK0017075>

⁸² Natural England (2014). European Site Conservation Objectives for The Wash Special Protection Area Site Code: Version 2, 3/062014 UK9008021 Available at: <http://publications.naturalengland.org.uk/publication/5747661105790976>

⁸³ Natural England (2015). Site Improvement Plan – The Wash & Norfolk Coast. Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future.

- Pressures and threats from commercial marine and estuarine fisheries and uncertainty of current management.
- Lack of predator control.
- Coastal squeeze causing loss and degradation of habitats due to the presence of coastal defences and sea level rise.
- Change in land management through under and over-grazing.
- Air pollution impacts, with the level of nitrogen deposition currently exceeding site-relevant critical loads.
- Changes in species distribution.

7.2.6 Qualifying habitats of the Wash SPA/Ramsar site/SAC in the Zone of Influence

There are 60 units within the Wash SSSI, the majority of which are in hydrological continuity with the Great River Ouse and all of which are littoral sediment. Littoral sediment includes shingle, gravel, sand and mud habitats, or a combination of these, which occur in the intertidal zone. These fall under saltmarsh habitat and are estuarine habitats, confirming the presence of habitat qualifying under Criterion 1 of the Wash Ramsar site.

Based on the habitat descriptions included in the European site citations summarised above and the component parts of the option, it is considered that the habitat features at risk from the implementation of the option are the intertidal mudflats and sandflats, sensitive to changes in the water table, sediment transport and water quality.

7.2.7 Qualifying bird species of The Wash SPA/Ramsar site/SAC in the Zone of Influence

All the qualifying bird species of The Wash SPA and Ramsar site have either been recorded during condition assessment surveys or have the potential to be supported by the habitats present in the ZoI. All the following species are therefore screened in to this Appropriate Assessment:

- Common Tern
- Little Tern
- Marsh Harrier
- Avocet
- Bar-tailed Godwit
- Golden Plover
- Whooper Swan
- Ringed Plover
- Sanderling
- Black-tailed Godwit
- Curlew
- Dark-bellied Brent Goose
- Dunlin
- Grey Plover
- Knot
- Oystercatcher
- Pink-footed Goose

- Pintail
- Redshank
- Shelduck
- Turnstone

7.3 Potential Impacts of NFN2 Kings Lynn Water Reuse

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UK WIP guidance (Table 2). The proposed location of the new Kings Lynn WRTW, the new Stoke Ferry WTW (sub-option A only), outfall and intake (sub-option A only) on the River Wissey and all associated pipelines are at a distance far enough beyond the boundaries of the European site (at least 1.5km), that no impacts from disturbance (noise/visual/light) or physical damage (habitat loss or degradation) through construction are anticipated. The closest location for the construction of the new transfer pipelines is 1.5km from the Wash, similarly no impacts from disturbance (noise/visual/light) or physical damage (habitat loss or degradation) through construction are anticipated.

There is uncertainty with regards to whether the infrastructure related to the implementation of the Plans would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size and scale of the proposed Kings Lynn water reuse option, the impacts with the potential to result in adverse effects are:

Construction Impacts

- Toxic contamination
 - Water pollution;
 - Air pollution.
- Physical damage
 - Habitat degradation.
- Biological disturbances
 - Changes to habitat availability.

Operational Impacts

- Water table / availability
 - Changes to surface water levels and flows.

Details of each of the potential adverse effect are given below, with the sensitivity of the qualifying species of the European sites considered. An assessment of how the impact might affect the integrity of the sites is made, in view of the sites' structure, function and conservation objectives. Where adverse impacts are deemed significant, mitigation measures are proposed in Section 7.4.

7.3.1 Construction Impacts

7.3.1.1 Toxic contamination

Water Pollution

During the construction period, construction works will be required within and in the vicinity of the River Great Ouse and River Wissey, particularly where the new transfer pipelines crosses

the River Great Ouse at Watlington and for the construction of the proposed outfall pipelines on the River Wissey, and intake at the new Stoke Ferry WTW (sub-option A only).

If a water pollution incident should occur, there is potential for adverse effects on water quality in the River Great Ouse or River Wissey, introducing a pathway to reduced water quality entering The Wash. Increased sedimentation may also occur through the movement of heavy plant vehicles adjacent to the river and in-river works. Sediment accretion has already been identified as a pressure in the Wash SPA and SAC Site Improvement Plan's, with any pollution impacts from the option therefore having the potential to exacerbate this.

If a water pollution incident should occur, a pathway exists to impact the European sites and may cause adverse effects on the qualifying habitat features, with potential knock-on impacts on the qualifying bird and mammal species. Anglian Water have ensured however, that directional drilling will be employed as a construction technique to avoid any in-channel works, thus avoiding any potential impacts on water quality during construction. Therefore, impacts as a result of water pollution during construction of the pipelines are not considered likely.

For the construction of the outfall on the River Wissey, there is a risk of discrete pollution events resulting in water pollution. As the River Wissey is hydrologically linked to The Wash, there is a pathway to the European sites which could result in adverse effects.

It is also possible that impacts on water pollution could have an indirect, knock-on effect on the physical habitat of the European sites, resulting in habitat degradation, which could in turn impact habitat availability and thus impact biological communities within the sites.

Air Pollution

Air pollution can result from the release of particulate matter (dust) into the atmosphere or through exhaust emissions from vehicles. Construction activities associated with the scheme are likely to involve dust generating activities during the construction phase, thereby potentially increasing air pollution in the area. While the distance at which significant effects are likely to occur is dependent on the extent and nature of mitigation measures, prevailing wind direction, and rainfall, effects from construction activities that generate dust are generally limited to within 150-200m⁸⁴.

The distance of the proposed desalination plant and pipelines from the European sites (>1.5 km), and the unlikelihood that air pollution will cause any significant adverse effects on water quality at river crossings means that impacts as a result of air pollution from dust are not considered likely. This effect is therefore scoped out from further assessment.

Toxic Contamination: Adverse Effects on Site Integrity

The interest features of the European sites which may experience adverse effects through water pollution are:

- The Wash SPA
 - Breeding and overwintering bird populations of European importance (common tern, little tern, marsh harrier, avocet, bar-tailed godwit, golden plover, whooper swan, ringed plover, curlew, dark-bellied goose, dunlin, grey plover, knot, oystercatcher, pink-footed goose, pintail, redshank, shelduck, turnstone and waterfowl): these species use intertidal and estuarine habitat for breeding feeding or loafing – these habitats are sensitive to pollution impacts.

⁸⁴ Highways Agency 2007, Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, HA207/07 (Air Quality). Available at: <<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20707.pdf>> [Accessed 22 November 2017].

- The Wash Ramsar site
 - Ramsar Criterion 1 (extensive saltmarshes, major intertidal banks of sand and mud, shall water and deep channels)
 - Ramsar Criterion 3 (inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters)
 - Ramsar Criterion 5 (the supporting habitat of waterbirds may be sensitive to reduced water quality entering the Wash)
 - Ramsar Criterion 6 (the supporting habitat of waterbirds may be sensitive to reduced water quality entering the Wash)
- The Wash & Norfolk Coast SAC
 - Sandbanks which are slightly covered by seawater all the time
 - Mudflats and sandflats not covered by seawater at low tide
 - Annex II species Harbour seal

7.3.2 Operation impacts

7.3.2.1 Water Table/ Availability

Changes to surface water levels and flows

In option A, effluent will be supplied from the current Kings Lynn WRC to the new WRTW, which will then be treated and pumped to the River Wissey. This will then be taken up by the new Stoke Ferry intake and pumped into the new Stoke Ferry WTW. In option B, the additional effluent in the River Wissey will be taken up by the existing Stoke Ferry WTW. There is potential for flows to reduce downstream of the new or existing intake at Stoke Ferry, which could consequently reduce flows in the River Great Ouse, which is one of the main contributors to the Wash. Changes to flows into The Wash are likely to affect habitats that support qualifying bird species, resulting in potential significant effects. A reduction in flows could also increase the amount of sediment accretion, which is a key issue already identified for the Wash.

However, considering the distance of the intake and outfall points from the European sites (approximately 40 km); the natural fluctuation in water levels of The Wash intertidal sites; and the likelihood that overall flows will be balanced between intake and outfall, it is considered that this effect will not result in a significant adverse impact on the qualifying habitats and species of the European sites.

Water table / availability: adverse effects on European sites

Given the tidal nature of the Wash estuary, freshwater input is only a minor contributor to levels and flows in the Wash. Consequently, no significant adverse effects from changes to surface water levels and flows are foreseeable on any of the qualifying features of the European sites.

7.4 Summary of Potential Impacts of the Option

The assessment of potential impacts of the Kings Lynn water reuse option given in Section 7.3 has identified the potential impacts that are considered likely to result in adverse effects on the conservation objectives and qualifying features of European sites. These are summarised in the below:

Table 35: Summary of potential adverse effects of NFN 1 Kings Lynn Desalination option on European sites

European Site	Potential Adverse Impact	Sensitive Interest Feature	Permanent or Temporary
The Wash SPA	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Breeding and overwintering bird populations	Temporary during construction only
The Wash Ramsar site	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Ramsar Criterion 1 (extensive saltmarshes, major intertidal banks of sand and mud, shall water and deep channels) Ramsar Criterion 3 (inter-relationship between its various components) Ramsar Criterion 5 (supporting habitat of waterbirds) Ramsar Criterion 6 (supporting habitat of waterbirds)	Temporary during construction only
The Wash & Norfolk Coast SAC	Toxic pollution (specifically water pollution) through construction of pipelines for intake and outfall points	Estuarine habitats Harbour seal	Temporary during construction only

7.5 Conclusions and Recommendations

7.5.1 Background

Sub-option A of the King's Lynn Water Reuse option includes the construction of a new WRTW adjacent to the existing Kings Lynn WRC, with a new pipeline between the two. The water treated at this new WRTW will be conveyed to a new outfall along the River Wissey via a new 29km transfer pipeline. The treated flow will then be abstracted downstream on the River Wissey (at a new abstraction point) to Stoke Ferry WTW for treatment prior to entering the potable water network.

Sub-option B of the King's Lynn Water Reuse option does not involve the new WTW at Stoke Ferry or the associated pipeline, or the new intake from the River Wissey. All other option elements are included.

It is assumed that the construction and commissioning phase of the option will last two years (18 months for construction and six months for commissioning), the equivalent of the short-term significance of the effect.

7.5.2 Summary of Potential Effects on European Sites

The HRA Task II: Appropriate Assessment considered the impact of a plan on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its structure and function. The Task II assessment can be addressed in answer to the following questions:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed WRMP option is not within the boundary of a European site.

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as bring in hydrological continuity with the proposed WRMP option:

- The Wash SPA including marine component;
- The Wash Ramsar site;
- The Wash & Norfolk Coast SAC.

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s), either directly or indirectly?

The assessment has identified there is a likelihood for adverse effects on the Wash SPA/Ramsar site/SAC during the construction of the option, which relate to pollution events resulting in potential adverse effects on water quality. No operational impacts are considered to result in significant adverse effects on the European sites.

7.5.3 Proposed Mitigation Measures

The full extent to which mitigation will be required will be determined at a lower-tier assessment, when finalised detailed design is available and an appropriate project-level HRA is undertaken. Anglian Water is committed to implementing the following mitigation measures and/or other mitigation measures should they be considered more appropriate at the project stage. The likelihood that appropriate mitigation cannot be incorporated into the design to minimise the impacts identified is low. The following mitigation measures are recommended:

- Water pollution:
 - Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW).⁸⁵
 - Anglian Water will use direction drilling to avoid in-stream works where the new pipeline crosses the River Great Ouse. This will minimise any potential impacts on the European sites downstream of the crossing.

7.5.4 Summary of the Task II: Appropriate Assessment

The Norfolk Valley Fens and Breckland European sites were not expected to experience any adverse effects from the water reuse option and were therefore scoped out of this assessment. This was because the sites are sufficiently upstream of any construction and operational impacts.

For the Wash SPA/Ramsar site/SAC, it is suggested that with appropriate mitigation, no significant adverse effects on the integrity of this site are reasonably foreseeable during construction and no significant effects are expected for the operation of the option.

The overall likelihood of adverse impacts of NFN2 Kings Lynn Water Reuse option on the qualifying features of the Wash European sites are summarised in Table 36.

⁸⁵ GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in GPP 5: Works and maintenance in or near water (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

Table 36: Assessment of potential adverse impacts of Kings Lynn desalination on the European qualifying features within the ZOI (X = adverse impact can be excluded; X^m= adverse impact is likely to be excluded following appropriate mitigation measures; X^p=adverse impact likely to be excluded following further investigation at project-level)

Potential impacts of SHB1 South Humber Bank Desalination

Qualifying feature	European sites	Potential impacts of SHB1 South Humber Bank Desalination								
		Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and	Change in salinity	Direct mortality
Sandbanks which are slightly covered by sea water all the time	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Mudflats and sandflats not covered by seawater at low tide	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Large shallow inlets and bays	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Reefs	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Salicornia and other annuals colonising mud and sand	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Atlantic salt meadows	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Mediterranean and thermos-atlantic halophilous scubs	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Costal lagoons	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Harbour seals	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Otter	The Wash & Norfolk Coast SAC	X	X	X	X	X ^m	X	X	X	X
Common Tern	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Little Tern	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Marsh Harrier	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Avocet	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Bar-tailed Godwit	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Golden Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Whooper Swan	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Ringed Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Sanderling	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Black-tailed Godwit	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Curlew	The Wash SPA	X	X	X	X	X ^m	X	X	X	X

Potential impacts of SHB1 South Humber Bank Desalination

Qualifying feature	European sites	Potential impacts of SHB1 South Humber Bank Desalination								
		Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Water pollution	Air pollution	Changes to surface water levels and	Change in salinity	Direct mortality
Dark-bellied Brent Goose	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Dunlin	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Grey Plover	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Knot	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Oystercatcher	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Pink-footed Goose	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Pintail	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Redshank	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Shelduck	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Turnstone	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Assemblage of waterfowl	The Wash SPA	X	X	X	X	X ^m	X	X	X	X
Ramsar Criterion 1	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X	X
Ramsar Criterion 3	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X	X
Ramsar Criterion 5	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X	X
Ramsar Criterion 6	The Wash Ramsar site	X	X	X	X	X ^m	X	X	X	X

8 NFN3 - Fenland Reservoir

8.1 Option Description

The Fenland Reservoir option is located in Feltwell and involves the following:

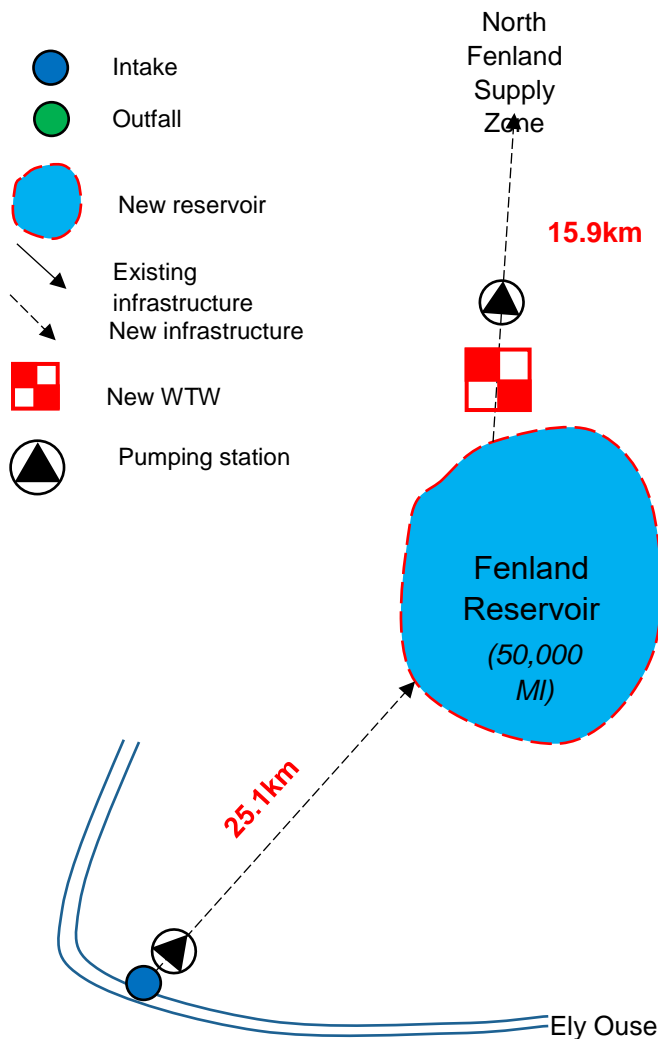
- Creation of a new reservoir approximately 60,000MI in size with a 4,100,100m² footprint.
- A new transfer pipeline (02b-0321-ai) would be required for the transfer of water from an existing intake (with existing pumping station) at Blackdyke (River Great Ouse) to Fenland Reservoir which is approximately 24km in length.
- From the reservoir, water will be transferred to Stoke water treatment works (WTW) via a new transfer pipeline 02b-0321-bii which is approximately 15km in length.
- Stoke Ferry WTW is existing but will require an upgrade.
- Pumping stations will be required on all transfers.

Please note, that since the Task I: Screening assessment there have been some changes to this option. Three sub-options for Fenland reservoir were considered in the Task I assessment, the sub-option chosen is now confirmed as that listed above. Therefore, the transfers 02b-0321aii: (River Trent to Fenland reservoir) and 02b-0321bi (Fenland reservoir to Heigham WTW) are no longer included in this option.

Enabling works are proposed to take two and a half years, construction works a further three years, and filling one and a half years, totalling seven years, which means some construction effects will be experienced in the medium term. However, as only five years of construction fall within the medium-term period of 23 years (for operation), the operation is taken as the dominant effect for this time period.

A schematic for this option is given in Figure 7.

Figure 7: Fenland Reservoir option schematic



Source: Anglian Water (August 2018)

8.2 Designated Sites in the Zone of Influence

The Task I: Screening assessment identified seven European sites where the Fenland reservoir option had the potential to result in adverse effects. As a result of the changes to this option since Task I: Screening assessment listed above (i.e. removal of transfers 02b-0321aii and 02b-0321bi), three of the European sites scoped in at the Task I: Screening assessment stage now lie outside the zone of influence (Zol) for this option and have been removed from this Appropriate Assessment.

The European sites scoped out of further assessment, and therefore with no potential adverse effects from this option are:

- Norfolk Valley Fens Special Area of Conservation (SAC)
- Barnack Hills and Holes SAC

- Breckland SAC

Four European sites remain where a potential impact pathway from this option is viable and therefore has the potential to result in adverse effects. These European sites are:

- Ouse Washes Special Protection Area (SPA)
- Ouse Washes Ramsar site
- Ouse Washes SAC
- Breckland SPA

The downstream toe of the Ouse Washes SPA/SAC/Ramsar site is within 500m of the new transfer pipeline 02b-0321 and the Task I: Screening assessment indicated that there is potential for this site to be affected through the construction and operation of the transfer. The Ouse Washes are also designated as a SSSI, and the condition assessment for the SSSI⁸⁶ provides a useful indication of the baseline condition of the site in terms of this HRA.

Breckland SPA is located within 500m of both transfer pipelines 02b-0321-ai and 2b-0321-bii; however, only a relatively small portion of the SPA lies within the Zol of the pipeline routes.

The option is shown in relation to these European sites in Appendix B.

The European sites with potential to be affected by the Fenland reservoir option are described in Section 8.2.1 to Section 8.2.6 below, along with their qualifying features, conservation objectives and vulnerabilities.

8.2.1 Ouse Washes SPA

The Ouse Washes SPA is an extensive area of seasonally flooding wet grassland ('washland') located between the Old and New Bedford Rivers; major tributaries of The Wash. It acts as a floodwater storage system during winter months and is grazed by cattle and used for hay production in the summer, giving rise to a mosaic of rough grassland and wet pasture, with a diverse and rich ditch fauna and flora. The washlands support both breeding and wintering waterbirds⁸⁷.

This site qualifies as an SPA under Article 4.1 of the Directive (79/409/EEC) by supporting over-wintering populations of European importance of the following species listed on Annex I of the Directive:

Table 37: Ouse Washes Annex I species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Hen harrier <i>Circus cyaneus</i>		X	
Bewick's swan <i>Cygnus columbianus bewickii</i>		X	
Whooper swan <i>Cygnus cygnus</i>		X	
Ruff <i>Philomachus pugnax</i>	X	X	
Spotted Crake <i>Porzana porzana</i>	X	X	

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of migratory species not listed on Annex I, and internationally important numbers of wildfowl and waders (see Table 2).

⁸⁶ Condition Assessment for Ouse Washes available at [https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S1000503&ReportTitle=Ouse WashesSSSI](https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S1000503&ReportTitle=Ouse+WashesSSSI)

⁸⁷ Ouse Washes SPA description (2001) <http://jncc.defra.gov.uk/default.aspx?page=2006>

Table 38: The Ouse Washes migratory species of international importance (SPA)

Article 4.2 Interest Feature	Breeding	Over winter	Passage
Northern shoveler <i>Anas clypeata</i>	x	x	
Mallard <i>Anas platyrhynchos</i>	x		
Garganey <i>Spatula querquedula</i>	x		
Shoveler <i>Anas strepera</i>	X	X	
Gadwall <i>Mareca strepera</i>	x	x	
Black-tailed godwit <i>Limosa limosa</i>	x	X	
Northern pintail <i>Anas acuta</i>		x	
Eurasian teal <i>Anas crecca</i>		x	
Eurasian wigeon <i>Mareca penelope</i>		x	
Pochard <i>Athya ferina</i>		x	
Tufted duck <i>Anas fuligula</i>		x	
Mute swan <i>Cygnus olor</i>		x	
Coot <i>Fulica atra</i>		x	
Cormorant <i>Phalacrocorax carbo</i>		x	
Over winter, the area regularly supports 64,428 individual waterfowl (5-year peak mean 1991/2 - 1995/6)	Lapwing, coot, tufted duck, mallard, teal, cormorant, black-tailed godwit, pochard, shoveler, pintail, gadwall, wigeon, ruff, whooper swan, Bewick's swan		

8.2.2 Ouse Washes Ramsar site

The Ouse Washes are an area of seasonally-flooded washland habitat managed in a traditional agricultural manner. The washlands support nationally and internationally important numbers of wintering waterfowl and nationally important numbers of breeding waterfowl. The site is also of note for the large area of unimproved neutral grassland communities which it holds, and for the richness of the aquatic flora within the associated watercourses.

The site qualifies for inclusion as a Ramsar site under four criteria of the Ramsar Convention on Wetlands of International Importance⁸⁸, as summarised in Table 39.

Table 39: The Ouse Washes Ramsar site

Criterion	Qualifying features of the Ramsar site	Notes
1	It contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	The site is one of the most extensive areas of seasonally-flooding washland of its type in Britain.
2	It supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	The site supports several nationally scarce plants, including small water pepper, whorled water-milfoil, greater water parsnip, river water dropwort, fringed water-lily, long-stalked pondweed, hair-like pondweed, grass-wrack pondweed, tasteless water-pepper Polygonum mite and marsh dock; Invertebrate records indicate that the site holds relict fenland fauna, including the British Red Data Book species large darter dragonfly and the rifle beetle; and

⁸⁸ JNCC (2007). Ramsar Information Sheet: UK11031. Humber Estuary. Produced by JNCC: Original Version 3.0, 13/06/2008. Available at: <http://jncc.defra.gov.uk/pdf/RIS/UK11031.pdf>.

Criterion	Qualifying features of the Ramsar site	Notes
		The site also supports a diverse assemblage of nationally rare breeding waterfowl associated with seasonally-flooding wet grassland.
5	It regularly supports 20,000 or more waterbirds.	Species with peak counts in winter: 59133 waterfowl (5-year peak mean 1998/99-2002/2003).
6	It regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Qualifying species/populations (as identified at designation): Species with peak counts in winter: tundra swan <i>Cygnus columbianus</i> , whooper swan <i>Cygnus cygnus</i> , Eurasian wigeon <i>Mareca penelope</i> , gadwall <i>Mareca strepera</i> , Eurasian teal <i>Anas crecca</i> , northern pintail <i>Anas acuta</i> , northern shoveler <i>Anas clypeata</i> Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in winter: mute swan <i>Cygnus olor</i> , common pochard <i>Athya ferina</i> , black-tailed godwit <i>Limosa limosa</i>

Source: JNCC, 2007

8.2.3 Ouse Washes SAC

The Ouse Washes SAC overlaps with the SPA. It contains inland water bodies, bogs, marshes, fens and improved grasslands. The site is designated as an SAC under Article 4.4 of the Directive (92/43/EEC) as it hosts species listed in Annex II, which are presented in the table below:

Table 40: Qualifying features of The Ouse Washes SAC

Annex II species that are a primary reason for site selection	Description
Spined loach <i>Cobitis taenia</i>	The Ouse Washes represent spined loach populations within the River Ouse catchment. The Counter Drain, with its clear water and abundant macrophytes, is particularly important, and a healthy population of spined loach is known to occur.

8.2.4 Conservation Objectives of the Ouse Washes⁸⁹

With regard to the SPA/SAC and the individual species and/or assemblage of species for which the site has been designated, the conservation objectives of the Ouse Washes are to ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features. The Ouse Washes SPA, SAC and Ramsar site overlap, so the conservation objectives for the Ramsar site are considered the same as for the SPA/SAC.

These objectives will be met by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

⁸⁹ Natural England (2014). European Site Conservation Objectives for The Ouse Washes Special Conservation Area. Site Code UK9008041. Version 3, 30/03/2014. Available at: <http://publications.naturalengland.org.uk/publication/6636062256398336>

8.2.5 Vulnerabilities of the Ouse Washes

The Site Improvement Plan (SIP) for the Ouse Washes SPA/SAC⁹⁰ identified the following as existing pressures, threats or activities that impact on the site:

- Inappropriate water levels
- Water pollution

Increased flooding on the Ouse Washes has adversely affected breeding birds, overwintering birds, and supporting grassland communities. In combination with inappropriate levels of nutrients from diffuse pollution (i.e. eutrophication), this has adversely affected the extent/composition of vegetation communities on the washes and has the potential to impact spined loach populations.

The majority of the Site of Specialist Scientific Interest (SSSI) units underlying the grassland habitats of this site have been assessed as being in an unfavourable condition. This is based on the decline of the majority of breeding bird features, some wintering bird features and the loss of extent and quality of MG11/MG13 neutral grassland feature.

These problems are being addressed by the Environment Agency and other bodies with an interest in managing the washes, through the Ouse Washes Management Strategy⁹¹. The Ouse Washes Habitat Creation Project adjacent to the Ouse Washes has been proposed to offset a historical decline of breeding and wintering bird species on the Ouse Washes.

An additional factor identified in the Ramsar Information Sheet⁹² as adversely affecting the site's ecological character is vegetation succession. A changing hydrological regime from increased levels of annual inundation and decades of high nutrient-status of receiving water have resulted in adverse changes in vegetation community type.

8.2.6 Breckland SPA

The Breckland of Norfolk and Suffolk is on largely sandy soils of glacial origin within East Anglia. Remnants of dry heath and grassland remain on this site and support heathland-breeding birds. Woodlark and nightjar breed in recently felled areas and open heath areas within conifer plantations, while stone curlew establishes nests on open ground provided by arable cultivation in the spring.

This site qualifies as an SPA under Article 4.1 of the Directive (79/409/EEC) by supporting breeding populations of European importance of species listed in Annex I of the Directive:

Table 41: Breckland Annex I species of international importance (SPA)

Annex I Species	Breeding	Over winter	Passage
Stone-Curlew <i>Burhinus oedichnemus</i>	x		
European nightjar <i>Caprimulgus europaeus</i>	x		
Woodlark <i>Lullula arborea</i>	x		

⁹⁰ Improvement Programme for England's Natura 2000 sites (IPENS). Planning for the Future. Site Improvement Plan Ouse Washes. Version 1.0 09/10/2014. Available at <http://publications.naturalengland.org.uk/publication/5354106084392960>

⁹¹ Mere Oak Ecology (2015). The Ouse Washes Literature Review. Vols 1-3. May 2015. Natural England. Available at: <http://ousewashes.org.uk/resources/downloads/management-of-the-ouse-washes-literature-review/> [Accessed 24th August 2017]

⁹² Ouse Washes Ramsar Information Sheet available at <http://jncc.defra.gov.uk/pdf/RIS/UK11051.pdf>

8.2.7 Conservation Objectives of Breckland SPA

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, the conservation objectives are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

8.2.8 Vulnerabilities of Breckland SPA⁹³

The Site Improvement Plan (SIP) for Breckland SPA identified the following as existing pressures, threats or activities that impact on the site:

- Insufficient creation and maintenance of bare ground
- Undergrazing by both livestock and wild rabbits
- Lack of available habitat through inadequate forestry and woodland management
- Water pollution through nutrient enrichment
- Planning permission and developments impacting species
- Insufficient monitoring
- Air pollution, impact of atmospheric nitrogen deposition
- Public access/disturbance
- Climate change
- Inappropriate scrub control, impacting heaths and grasslands
- Habitat fragmentation, resulting in isolated heaths
- Inappropriate management practices
- Inappropriate weed control
- Inappropriate pest control

There is insufficient creation and/or maintenance of bare ground and early successional vegetation communities (dry heath, dune, and calcareous grassland), which affects the supporting habitat of the SPA species. Stone-curlew, nightjar and woodlark are vulnerable to predation from corvids and foxes and to disturbance caused by human activity, including dog-walking.

Breckland heathlands and acid grasslands supporting stone-curlew, nightjar and woodlark are fragile in terms of the high background levels of air pollution in the area, particularly high nitrogen loads causing undesirable habitat changes. There are development pressures on the area, particularly for infrastructure. Collecting of eggs of stone-curlew, and to some extent nightjar and woodlark, is believed to be a serious threat to individual birds and to population size. The loss of eggs to this illegal activity is not known.

⁹³ Natural England (2014). Improvement Programme for England's Natura 2000 Sites (IPENS) Site Improvement Plan: Breckland. file:///C:/Users/joh62944/AppData/Local/Packages/Microsoft.MicrosofEdge_8wekyb3d8bbwe/TempState/Downloads/SIP150121FINALv1.0%20Breckland.pdf

8.2.9 Qualifying habitats of the Ouse Washes SPA/Ramsar site/SAC and Breckland SPA within the Zone of Influence

The Ouse Washes SSSI units in the Zol of the transfer are SSSI Unit 20 and 21, comprising a flood defence barrier bank and improved, seeded grassland as well as a stretch of the Hundred Foot River.

Depending on winter flood levels on the washland grassland, the barrier bank can form a refuge for grazing winter ducks e.g. wigeon and mallard. Along the margins, there are opportunities for some breeding birds such as reed bunting and sedge warbler. The barrier bank grassland is managed by a combination of cutting and grazing and some areas are managed under a number of agri-environment schemes.

The Hundred Foot River forms a part of the River Great Ouse which runs along the south-eastern boundary of the Ouse Washes, which supplies water to the internal ditch system during dry, unflooded summers. There is no botanical interest in this river and no evidence that there ever has been; the botanical interest is in the internal ditch system and the two parallel main drains the other side of the Washes. Therefore, this unit has been assessed for its contribution to the breeding bird interest of the site for sedge warbler and reed bunting.

Both units in the Zol of the option are in favourable condition. 80% of total area of the Ouse Washes are assessed as being in unfavourable condition, due to the pressures identified in Section 8.2.5, resulting in a decline in the majority of breeding bird features, some wintering bird features and the loss of extent and quality of MG11/MG13 neutral grassland feature.

The areas of the Breckland SPA correspond to Breckland Farm SSSI unit 69, 32 and 34 – listed as arable and horticulture land in favourable condition on the Breckland Farm SSSI unit condition assessment⁹⁴, suitable for nesting stone-curlew in spring.

8.2.10 Qualifying bird species of the Ouse Washes SPA/Ramsar site/ SAC and Breckland SPA within the Zone of Influence

All the qualifying bird species of The Ouse Washes SPA, Ramsar site and SAC or Breckland SPA have either been recorded during condition assessment surveys or have the potential to be supported by the habitats present in the Zol. All the following species are therefore screened in to this Appropriate Assessment:

- Stone curlew
- Nightjar
- Woodlark
- Ruff
- Spotted crane
- Bewick's swan
- Hen harrier
- Ruff
- Whooper swan
- Black-tailed godwit
- Gadwall

⁹⁴ Condition assessment for Breckland Farm SSSI available at <https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S2000442&ReportTitle=Breckland%20Farmland%20SSSI>

- Pintail
- Shoveler
- Pochard
- Wigeon
- Waterfowl assemblage

8.2.11 Qualifying fish species of the Ouse Washes SAC within the Zone of Influence

The Counter Drain of the Ouse Washes, with its clear water and abundant macrophytes, supports important populations of spined loach. It cannot be ruled out that this species is not present in the Hundred Foot River.

8.3 Potential Impacts of the NFN3 Fenland Reservoir option

A literature review of the sensitivity of the qualifying features of the European sites has been undertaken and is summarised in Appendix A. Based on the findings of this study and details of the proposed option, potential impacts on the qualifying features have been identified in line with UKWIR guidance. Depending on the nature and magnitude of the proposed options and the sensitivity of the qualifying features of the European sites, the potential resulting impacts may vary.

There is uncertainty with regards to whether the infrastructure related to the implementation of the WRMP would ever be decommissioned in the future and therefore decommissioning has not been considered at this time. Considering the type, size and scale of the proposed Fenland reservoir option, the impacts with the potential to result in adverse effects are:

Construction Effects

- Non-physical disturbance
 - Noise disturbance
 - Visual presence
 - Light pollution
- Toxic contamination
 - Water pollution

Operational Effects

- Physical damage
 - Habitat degradation
- Water table / availability
 - Changes to surface water levels and flows
- Non-toxic contamination
 - Changes in sedimentation/silting
- Biological disturbances
 - Changes to habitat availability

Details of each of the potential adverse effects are given below, with the sensitivity of the qualifying species of the European sites considered. An assessment of how the impact might affect the integrity of the sites is made, in view of the sites' structure, function and conservation objectives. Where adverse impacts are deemed significant, mitigation measures are proposed in Section 8.5.

8.3.1 Construction Impacts

8.3.1.1 Non-physical Disturbance

Noise Disturbance

A pathway exists for noise disturbance during the construction phase to result in a change in the number and distribution of species within the Zol. The construction of the new reservoir and underground pipelines from the River Great Ouse and to Stoke Ferry WTW would involve the use of methods such as directional drilling. Construction methods are known to be a particular issue in relation to disturbance to wetland birds⁹⁵, with noise levels above 70db(A) at the receptor likely to cause moderate to high effects. In general, birds tend to habituate to continual noises so long as there is no large amplitude 'startling' component, with vehicle movements being more greatly tolerated⁹⁶.

The pipeline routes 02b-0321-ai, from the River Great Ouse to the proposed reservoir, and 02b-0321-bii, from the proposed new reservoir to Stoke Ferry WTW, are directly adjacent to the western boundary of Breckland SPA where there is suitable habitat for nesting stone curlew. Construction activities therefore have the potential to result in disturbance on this qualifying feature of Breckland SPA.

Visual Presence

A pathway exists in the form of visual disturbance relating to the ability of the birds to view human activity and the possibility that they may be disturbed by increased movement during construction. The distance in which birds take flight when approached by people walking varies significantly. A review by Borgmann⁹⁷ found flight initiation distance ranged from 12 to 160m, whereas Cutts et al⁹⁸ observed flight initiation at 200m. This disturbance impact has the potential to occur during construction of the transfer pipelines 02b-0321-ai and 02b-0321-bii, which are adjacent to the western boundary of Breckland SPA, where there is suitable habitat for nesting stone-curlew. Impacts from visual presence are not reasonably foreseeable during the operation phase, as the proposed site of the reservoir is outside the Zol of any European sites.

Light Pollution

The use of artificial lighting during construction (and operation) can result in light spill, with an overall increase in light levels within the Zol resulting in the potential change in behaviour of birds, resulting in displacement. There is a potential for the construction of the pipeline transfers 02b-0321-ai and 02b-0321-bii, which are adjacent to the western boundary of Breckland SPA to result in light pollution.

Non-Physical Disturbance: Adverse Effects on Site Integrity

Non-physical disturbance is only considered likely in relation to the construction of the transfer pipelines 02b-0321-ai and 02b-0321-bii adjacent to the western boundary of Breckland SPA.

⁹⁵ Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R. & Treweek, J.(1997). Bird disturbance: improving the quality and utility of disturbance research. *J. Appl. Ecol.* 34: 275–288.

⁹⁶ Hockin, D., Ounsted, M., Gorman, M., Hill, D., Keller, V. & Barker, M.A.(1992). Examination of the effects of disturbance on birds with reference to its importance in ecological assessments. *J. Environ. Manage.* 36: 253–286.

⁹⁷ Borgmann, K.L. (2011). A Review of Human Disturbance Impacts on Waterbirds. [pdf] Available at: <http://www.yourwetlands.org/pdf/A%20Review%20of%20Human%20Disturbance%20Impacts%20on%20Waterbirds.pdf> [30th August 2017].

⁹⁸ Cutts, N., Phelps, A. & Burdon, D. (2009). Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance. The University of Hull, Hull.

Given the agricultural setting of the land within the ZoI, the only qualifying features of Breckland SPA with potential sensitivity to non-physical disturbance impacts is stone-curlew.

All other European sites are beyond 500m of the proposed option, with no significant impacts from non-physical disturbance therefore anticipated.

Given the habitats present in the ZoI, the interest features of the European sites which may experience adverse effects through non-physical disturbance are:

- Breckland SPA
 - Stone curlew (disturbance impacts from noise, human presence and light pollution are likely during the construction phase, which may affect the distribution of the species in the site).

8.3.1.2 Toxic Contamination

Water Pollution

Construction works and operations in or near water (including ground water) have the potential to result in ingress of harmful substances including: contaminated water; concrete, cement and grout; oils and chemicals; trade materials. The proposed pipeline routes 02b-0321-ai and 02b-0321-bii run partially adjacent to and cross the Cut-Off Channel at a point bordering Breckland SPA. Pipeline 02b-0321-ai from the Denver sluice is hydrologically connected to the Ouse Washes SPA/Ramsar site/SAC being approximately 750m (Euclidean distance) from the boundary. There is potential for pollution events to occur during construction, which may impact water quality and associated habitats, potentially supporting qualifying species of the European site.

Toxic Contamination: Adverse Effects on Site Integrity

The interest features of the European sites which may be affected by toxic contamination (specifically water pollution) are:

- Ouse Washes SPA
 - migratory and overwintering species of European importance: wigeon and mallard (sensitive to water quality which may affect feeding and breeding habitat).
 - Waterfowl adding to internationally important numbers: reed bunting and sedge warbler (sensitive to water quality which may affect feeding and breeding habitat).
- Ouse Washes Ramsar site
 - Ramsar Criterion 1 (seasonally-flooding washland is sensitive to water quality, with eutrophication due to high nutrient levels listed as a vulnerability in the Ramsar Information Sheet (RIS)).
 - Ramsar Criterion 2 (the plants are all reliant on aquatic habitat and are therefore sensitive to water pollution. Although there is no botanical interest in the waterbody in the ZoI, the Hundred Foot River feeds the internal ditch system and the two parallel main drains where botanic interest is high. Changes in the vegetation community of the site due to the nutrient of receiving water has been identified in the RIS).
- Ouse Washes SAC
 - Spined loach (sensitive to water pollution due to specialist feeding mechanism. The Counter Drain in Ouse Washes is particularly important for the species due to its clear water and abundant macrophytes, but it cannot be ruled out that this species is not present in the Hundred Foot River).

None of the qualifying features of Breckland SPA likely to be present in the Zol (i.e. stone-curlew) are sensitive to the water pollution therefore toxic contamination is unlikely to result in adverse effects on this site.

Although there is a minimal risk of pollution events to waterbodies during construction as a result of good practice pollution prevention practices there is still a small risk of occurrence, therefore the risk of toxic contamination during construction must be considered. Water pollution has the potential to result in adverse effects on all the sensitive interest features of the Ouse Washes listed. Current construction good-practice dictates that these changes are likely to be significant during construction only and therefore temporary, but with the potential to result in adverse effects on the integrity of the Ouse Washes without the implementation of appropriate mitigation.

8.3.2 Operational Impacts

8.3.2.1 Physical Damage

Habitat Degradation

The footprint of the proposed Fenland reservoir is outside any of the European sites and therefore no direct impacts in terms of physical loss of habitat are anticipated. However, filling of the proposed new reservoir will require increasing the intake at Blackdyke/Denver Sluice on the River Great Ouse by 454.0Ml/d to feed the new transfer pipeline 02b-0321-ai to the new reservoir. There is requirement for a new inlet at the Cut-off Channel to facilitate this feature. The watercourse at Blackdyke is hydrologically connected to the Ouse Washes SPA/Ramsar site/SAC, therefore there is potential for hydrological changes as a result of sustained reduction in water levels feeding the system. A sustained reduction in water levels at the Ouse Washes has the potential to result in the long-term degradation of aquatic habitats such as reedbeds and drying out of marginal vegetation. The Zol for abstraction is considered up to 5km from source to capture all hydrological connections, therefore the Ouse Washes as a whole should be considered in the Zol.

The qualifying features of the European sites with potential sensitivity to physical damage (habitat degradation) are as follows:

- Ouse Washes SPA (hydrologically connected to watercourse from which increased abstraction is proposed)
 - Hen harrier (sensitive to deterioration of wetland habitat, with the loss of marshland habitat cited as a main threat to the species)
 - Bewick's swan (sensitive to loss of wetland habitat)
 - Whooper swan (threatened by degradation of wetland habitat)
 - Ruff (sensitive to deterioration of wetland habitat, being threatened by changing land management that leads to scrub overgrowth)
 - Northern shoveler (sensitive to deterioration of wetland habitat, being threatened by habitat loss, including of wetlands and flooded grasslands)
 - Mallard (sensitive to wetland degradation)
 - Garganey (sensitive to wetland degradation, with breeding grounds in Europe threatened through drainage and reclamation of wetlands)
 - Gadwall (sensitive to habitat degradation, which includes marshy grassland/flood meadow)

- Black-tailed godwit (sensitive to habitat degradation, with declines believed to be loss and degradation of breeding habitat of semi-natural meadows)
- Northern pintail (sensitive to wetland degradation, with habitat destruction identified as a main threat in the EU)
- Eurasian teal (sensitive to wetland degradation; primarily feeding on seeds of aquatic plants during winter)
- Eurasian wigeon (sensitive to wetland degradation)
- Pochard (sensitive to wetland degradation)
- Tufted duck (sensitive to wetland degradation)
- Mute swan (sensitive to wetland degradation)
- Coot (sensitive to wetland degradation)
- Cormorant (sensitive to wetland degradation)
- Waterbird assemblage (sensitive to wetland degradation)
- Ouse Washes Ramsar
 - Ramsar Criterion 1 (seasonally-flooding washland is sensitive to hydrological changes, with inappropriate water levels already recognised as a threat to this site)
 - Ramsar Criterion 2 (the plants and invertebrates listed in the RIS are all sensitive to hydrological changes. Increased abstraction has the potential to alter the underlying physical conditions required for plant species such as small water pepperwort and whorled water-milfoil, with knock-on impacts on the supporting habitat of invertebrate and waterfowl species. Adverse change in vegetation communities in relation to changing hydrological regime was identified as a vulnerability in the RIS)
 - Ramsar Criterion (sensitivities as per bird species in Ouse Washes SPA)
- Ouse Washes SAC
 - Spined loach (sensitive to habitat change due to specialist feeding mechanism. The Counter Drain in Ouse Washes is particularly important for the species due to its clear water and abundant macrophytes)

There is no impact pathway for habitat degradation or any other physical damage to occur in Breckland SPA, as the option is outside the boundary of the site.

Physical Damage – Adverse Effects on Site Integrity

The option proposes increased abstraction of 454.0MI/d from the Ely Ouse by abstracting water from the Cut Off Channel which is fed by abstractions at Denver Sluice. Hydrological modelling in the Ely Ouse catchment (based on increased abstraction during medium and high flows only) concluded that there is significant water available for abstraction from the Ely Ouse in most years⁹⁹. It is understood that abstraction will only be carried out above the Hands Off Flow (HoF), ensuring abstraction in medium and high flow conditions only. Therefore, it can be safely assumed that low flow conditions will not occur as a direct result of this abstraction. The abstraction point is at the downstream toe of the Ouse Washes, therefore given the assumption is abstracting at medium and high flows only, any reduction in surface water levels or flows as a result of the increase of 454.0MI/D is only likely to be localised, thereby result in minor changes to the stretch of waterbody at the abstraction point and downstream of the Ouse Washes SPA/Ramsar site/SAC only.

⁹⁹ Mott MacDonald (2017b). Anglian Water WRMP19 Supply Option Development: Reservoirs. 28 February 2017.

The Environment Agency's Review of Consents (RoC) considers existing abstractions at their licence limits and ensures that maximum abstraction does not result in significant effects on European sites. Although this option is proposing a new pipeline to transfer water from the Ely Ouse to the new Fenland reservoir, a current abstraction will be increased, therefore it is covered under the protection of the RoC.

Considering the assessment given, significant reduction in water levels and flows resulting in habitat degradation is not considered likely at the Ouse Washes as a result of this option. The qualifying features of the European sites that are sensitive to this impact are therefore unlikely to be affected, and no adverse effects on the Ouse washes SPA/Ramsar site/SAC as a result of physical damage (habitat degradation) is therefore concluded.

8.3.2.2 Water Table/Availability

Changes to Surface Water Levels and Flows

The proposed Fenland reservoir will be filled through a new transfer pipeline 02b-0321-ai from the Cut Off Channel in the River Great Ouse. This will require an increase in abstraction of 454.0Ml/D from Blackdyke/Denver sluice, which feeds the Cut Off Channel. The watercourse at Denver sluice is hydrologically connected to the Ouse Washes SPA/ Ramsar site/SAC. Therefore, there is potential for hydrological changes as a result of sustained reduction in water levels feeding the system. A sustained reduction in water levels at the Ouse Washes has the potential to result in the long-term degradation of aquatic habitats such as reedbeds and drying out of marginal vegetation. The Zol for abstraction is considered up to 5km from source to capture all hydrological connections, therefore the Ouse Washes whole as a whole should be considered in the Zol

The qualifying features of the European sites with potential sensitivity to changes in water table/availability (i.e. reduction in surface water levels and flows) are identical to those listed in Section 8.3.2.1 above, listed as sensitive to habitat degradation as a result of physical damage from reduced water levels and flows. The assessment for this impact should be considered the same as for physical damage (habitat degradation).

Water Table/Availability – Adverse Effects on Site Integrity

Given the tidal nature of the Ouse Washes, freshwater input is only a minor contributor to levels and flows in the site. There is no pathway for impact on Breckland SPA as the option is outside the boundary of the site, with no hydrological connection to proposed uptake and outfall locations. Consequently, no significant adverse effects from changes to surface water levels and flows are foreseeable on any of the qualifying features of the European sites.

8.3.2.3 Non-toxic Contamination

Changes to Sedimentation / Silting

Increased abstraction from the Blackdyke/Denver sluice has the potential to result in a reduction in surface water levels and flows, thus increase sediment supply through changes in the natural hydrology of the watercourse. The abstraction at Denver Sluice is hydrologically connected to the Ouse Washes SPA/Ramsar site/SAC, therefore there is potential for hydrological changes resulting in increased sedimentation as a result of sustained reduction in water levels feeding the system. Excess sediment in the water column can have damaging effects on fish, as well as

potential wider impacts on the ecosystem through the transfer of pollutants, reduction in primary productivity and lowering of oxygen levels¹⁰⁰.

The qualifying features of the European sites with potential sensitivity to sedimentation / silting are as follows:

- Ouse Washes Ramsar
 - Ramsar Criterion 1 (washland and other floodplain habitats are sensitive to sediment levels, with increased sedimentation potentially leading to excess deposition. This can alter the nutrient status of the soil and lead to a change in plant species composition).
 - Ramsar Criterion 2 (aquatic plant communities are sensitive to sedimentation through changes in light penetration and oxygen levels, thereby potentially impacting the suitability of the site for the species listed in the RIS. This may lead to knock-on effects on the listed invertebrate species through impacts to their supporting habitats and plant communities).
- Ouse Washes SAC
 - Spined loach (sensitive to sediment regime of habitat due to specialist feeding mechanism. The species has a preference for sandy substrate, with a target set for Ouse Washes of at least 20% sand and no more than 40% silt¹⁰¹).

The qualifying bird species of the Ouse Washes SPA and Ramsar sites will not be directly impacted by sedimentation changes, however, there is potential for indirect impacts through changes to their supporting aquatic habitats such as marginal vegetation and reedbeds as a result of increased sedimentation. There is no pathway for impact on Breckland SPA as the option is outside the boundary of the site, with no hydrological connection to proposed uptake and outfall locations.

Non-Toxic Contamination – Adverse Effects on Site Integrity

As detailed in the assessment for physical damage (habitat degradation) in Section 8.3.2.1, significant reduction in water levels and flows is not considered likely at the Ouse Washes as a result of this option. Therefore, increased sedimentation as a result of a reduction in surface water levels and flows is also not reasonably foreseeable. The qualifying features of the European sites that are sensitive to this impact are therefore unlikely to be affected, and no adverse effects on the Ouse washes SPA/Ramsar site/SAC as a result of non-toxic contamination (increased sedimentation/silting) is therefore concluded.

8.3.2.4 Biological Disturbances

Changes to Habitat Availability

Proposed increased abstraction in a watercourse hydrologically linked to the Ouse Washes SPA/Ramsar site/SAC may impact the physical properties underlying the qualifying habitats of the European sites and their associated species.

Changes in the receiving water body at Stoke Ferry WTW is not within the Zol of any European sites, therefore biological disturbance impacts as a result of the transfer pipeline 02b-0321-bii is not reasonably foreseeable. The qualifying features of the European sites with potential

¹⁰⁰ Environment Agency (2011). Sediment matters. April 2011. Available at: <https://www.gov.uk/government/publications/sediment-matters> [Accessed 30th August 2017]

¹⁰¹ Natural England (2015). European Site Conservation Objectives: Supplementary advice on conserving and restoring site features Ouse Washes Special Area of Conservation (SAC) (UK0013011). May 2015.

sensitivity to changes in habitat availability are the same as those qualifying features listed for physical damage (habitat degradation) in Section 8.3.2.1 above.

Biological Disturbance – Adverse Effects on Site Integrity

Adverse impacts on the Ouse Washes SPA, Ouse Washes Ramsar and Ouse Washes SAC are not anticipated through changes to habitat availability. As habitat degradation within the European sites is not anticipated, due to the unlikelihood of a significant reduction in surface water levels and flows (as detailed for physical damage (habitat degradation) in Section 8.3.2.1 above, there are no reasonably foreseeable impacts on the supporting habitats of the qualifying species.

8.4 Summary of Potential Impacts of the Option

The assessment of potential impacts of the Fenland reservoir option given in Section 8.3 has identified the potential adverse impacts that are considered likely to result in significant effects on the conservation objectives and qualifying features of European sites. These are summarised in Table 42 below.

Table 42: Summary of potential adverse effects of Fenland reservoir on European sites

European site	Potential adverse impact	Sensitive interest feature	Permanent or temporary
Breckland SPA	Non-physical disturbance (noise/visual presence/light pollution) through construction of both transfer pipelines	Stone-curlew (breeding)	Temporary during construction only
Ouse Washes SPA	Toxic contamination (specifically water pollution) through construction of transfer 02b-0321-ai	wigeon, mallard, reed bunting and sedge warbler (migratory/ overwinter)	Temporary during construction only
Ouse Washes Ramsar site	Toxic contamination (specifically water pollution) through construction of transfer 02b-0321-ai	Ramsar Criterion 1 (unique near-natural washland) and Criterion 2 (vulnerable or endangered plants and invertebrates)	Temporary during construction only
Ouse Washes SAC	Toxic contamination (specifically water pollution) through construction of transfer 02b-0321-ai	Spined loach	Temporary during construction only

8.5 Conclusions and Recommendations

8.5.1 Background

The Fenland Reservoir option is located in Feltwell and involves the creation of a new reservoir, a new transfer pipelines, upgrades to Stoke Ferry WTW and pumping stations on all transfers.

Enabling works are proposed to take two and a half years, construction works a further three years, and filling one and a half years, totalling seven years.

8.5.2 Summary of Potential Effects on European Sites

A HRA Task II: Appropriate Assessment considered the impact of a plan on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its structure and function. The Task II assessment can be addressed in answer to the following:

1. Is the proposed WRMP option within the boundary of a European site?

The proposed WRMP is not within the boundary of a European site.

2. Is the proposed WRMP option in hydrological continuity with a European site?

The European sites listed below were identified as being in hydrological continuity with the proposed WRMP option:

- Ouse Washes SPA;
- Ouse Washes Ramsar site;
- Ouse Washes SAC;
- Breckland SPA.

3. Does the WRMP option have the potential to adversely affect the integrity of the European site(s), either directly or indirectly?

The assessment has identified that there is a likelihood for temporary adverse effects on the Ouse Washes SPA/Ramsar site/SAC and Breckland SAC as a result of implementation of the option. These impacts relate to (1) water pollution (Ouse Washes) and (2) noise/visual presence/light disturbance (Breckland) during the construction phase only.

8.5.3 Proposed Mitigation Measures

The following mitigation measures are considered appropriate to be incorporated in to the construction methodology of this option. It is considered, on the basis of the available information, that the option is unlikely to result in adverse effects on the integrity of Ouse Washes SPA/Ramsar site/SAC and Breckland SAC or their interest features if such mitigation is employed:

- Mitigation for water pollution:
 - Implement current best practice guidance for pollution prevention 'Guidance for Pollution Prevention. Works and maintenance in or near water: GPP 5' issued by the Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA) and Natural Resources Wales (NRW)¹⁰².
- Mitigation for noise disturbance
 - Construction activities within 500m of Breckland SPA to be programmed to avoid key seasons in bird ecology. This will require consultation and agreement with Natural England in relation to the qualifying birds of the Breckland SPA designation but is likely to be required avoidance of the core breeding season from March to August, and the overwintering period from November to February.
 - Construction related noise disturbance can be further minimised by implementing best practice such as BS 5228-1:2009+A1:2014¹⁰³.
- Mitigation for visual (human) presence:

¹⁰² GPP is now considered the best practice guidance for pollution prevention in the UK after a review of the former pollution prevention guidance (PPGs) was undertaken and former PPGs withdrawn in 2015. The replacement guidance series, Guidance for Pollution Prevention (GPPs) provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales. For businesses in England, regulatory guidance is available from GOV.UK. The former PPG1 (general guide to the prevention of water pollution), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites) and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites is compiled in [GPP 5: Works and maintenance in or near water](http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf) (2017, available at <http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf>)

¹⁰³ The British Standards Institute (2008). BS 5228-1:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise. BSI Standards Limited, London.

- Construction activities within 500m of Breckland SPA to be programmed to avoid key seasons in bird ecology. This will require consultation and agreement with Natural England in relation to the qualifying birds of the Breckland SPA designation but is likely to be required avoidance of the core breeding season from March to August, and the overwintering period from November to February.
- If construction work within this timeframe and area cannot be avoided, construct low level screening along the boundary of the site to prevent birds seeing into the operational areas, thereby preventing visual and human disturbance.
- Mitigation for light pollution:
 - Should the works be undertaken at night and flood lighting required, lighting will be kept to a minimum and hooded spot lights directed away from potential suitable habitat, to reduce disturbance while ensuring standards for health and safety.
 - The potential impact of artificial light will be minimised through the implementation of best practice such as ‘Guidance Notes for the Reduction of Obtrusive Light’¹⁰⁴.

8.5.4 Summary of Task II: Appropriate Assessment

For the impacts identified during construction of this option, appropriate mitigation measures will be put in place to ensure there is no residual effects on the qualifying features of the European sites identified in the ZoI. No significant adverse effects are reasonably foreseeable on the integrity of European sites as a result of operation if these mitigation measures are employed.

The overall likelihood of adverse impacts of the Fenland reservoir option on the qualifying features are summarised in Table 43.

Table 43: Assessment of potential adverse impacts of Fenland reservoir on the European qualifying features within the ZoI (✓ = adverse impact cannot be excluded; X = adverse impact can be excluded; Xm= adverse impact can be excluded following defined mitigation measures)

		Potential impacts of NFN3 Fenland reservoir							
Qualifying feature	European sites	Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Drying; Water Levels and Flows	Water pollution	Sedimentation / Silting	Habitat Availability
		Hen harrier	Ouse Washes SPA	X ^m	X	X	X	X	X ^m
Bewick's swan	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Whooper swan	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Ruff	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Northern shoveler	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Mallard	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Garganey	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Gadwall	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X

¹⁰⁴ Institute of Lighting Professionals (2011). Guidance notes for the reduction of obtrusive light. Available at: <http://www.wiltshire.gov.uk/guidance-notes-for-the-reduction-of-obtrusive-light.pdf>. [Accessed 30th August 2017]

Potential impacts of NFN3 Fenland reservoir

Qualifying feature	European sites	Potential impacts of NFN3 Fenland reservoir							
		Habitat Degradation	Noise Disturbance	Visual Presence	Light Pollution	Drying; Water Levels and Flows	Water pollution	Sedimentation / Silting	Habitat Availability
Black-tailed godwit	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Northern pintail	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Eurasian teal	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Eurasian wigeon	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Pochard	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Tufted duck	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Mute swan	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Coot	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Cormorant	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Waterbird assemblage	Ouse Washes SPA	X ^m	X	X	X	X	X ^m	X	X
Seasonally-flooding washland (Ramsar Criterion 1)	Ouse Washes Ramsar	X ^m	X	X	X	X	X	X ^m	X
Nationally scarce plants (Ramsar Criterion 2)	Ouse Washes Ramsar	X ^m	X	X	X	X	X ^m	X ^m	X
Invertebrate species of the British Red Data Book (Ramsar Criterion 2)	Ouse Washes Ramsar	X ^m	X	X	X	X	X ^m	X ^m	X
Spined loach	Ouse Washes SAC	X ^m	X	X	X	X	X ^m	X ^m	X
Stone-curlew	Breckland SPA	X	X ^m	X ^m	X ^m	X	X	X	X
European nightjar	Breckland SPA	X	X ^m	X ^m	X ^m	X	X	X	X
Woodlark	Breckland SPA	X	X ^m	X ^m	X ^m	X	X	X	X

9 In-Combination Effects Assessment

The HRA process requires an “in-combination” assessment to consider if other projects, plans or programmes, in conjunction with the project or plan being assessed, may result in significant adverse effects on the integrity of European sites. In relation to the WRMP process, there are several sources of potential in-combination effects which should be considered. These are as follows:

- Intra-plan effects: different options within WRMP which have the potential to affect the same European site;
- Inter-plan effects: effects in combination with other plans (e.g. WRMPs of bordering water companies; ongoing flood risk management plans, etc.) which through additive impacts may result in adverse effects on the same European site;
- Inter-project effects: the in-combination effects of a specific option within the WRMP with other specific projects and developments proposed in the locality.

The Task I: Screening assessment made a preliminary assessment of the potential cumulative effects of options included in the WRMP, considering any European sites that could be affected by the implementation of the WRMP. This Task II: Appropriate Assessment presents a more detailed in-combination review, after any potential adverse effects on the integrity of European sites have been assessed, resulting from the options within the WRMP.

Due to the strategic nature of the WRMP, the options have not progressed to specific design-level and there is uncertainty regarding the timeline for implementation of each of the options. The options that form the WRMP will be subject to the formal planning process and may require an Environmental Impact Assessment under the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended), which will include a project-level HRA assessment. The large supply options proposed under the adaptive strategy (e.g. new reservoirs and desalination plants) may be classified as ‘Nationally Significant Infrastructure’ and would therefore be required to go through the Development Consent Order planning route, which would itself require its own project-level HRA assessment. As part of these processes, more detail in the design of these options will have progressed, and option-specific mitigation measures will be developed. It is therefore considered that in-combination effects between the options of WRMP (i.e. intra-plan effects) will be understood in more depth at the project-stage.

Given the uncertainty of the long-term impacts of brine discharge into the marine environment, a conclusive assessment of the desalination options has not been given in this Task II: Appropriate Assessment and further assessment is recommended at the project-stage HRA. Regardless, an attempt has been made to provide a conclusive in-combination effects assessment in this chapter should the desalination options be implemented without the retrospect of any further assessment.

Regarding inter-plan and inter-project effects, it should be noted that the timescales of neighbouring Water Company’s WRMPs and Drought Plans may not be aligned with the timescale of Anglian Waters WRMP, therefore draft plans have been reviewed where possible, and these are therefore subject to change on publication of the final plan documents. It is assumed however, that any potential significant effects on European sites due to individual options, or in-combination effects will be avoided as far as reasonably possible, and ultimately no options that will result in residual effects (either alone or in-combination) will be implemented as part of the WRMP implementation.

The preliminary in-combination effects assessment given in the Task I: Screening report has scoped-out any possibility of cumulative effects from Local Plans or the Environment Agency's Review of Consents process, therefore they are not considered further in the Task II assessment.

The in-combination assessment for intra-plan, inter-plan and inter-project effects is given in the following sections.

9.1 Intra-Plan Effects

This section aims to provide an assessment of the potential in-combination effects of options included in the WRMP. The in-combination assessment shows that none of the options included in the WRMP have the potential to act in-combination to result in residual effects on European sites. There is no combination of options that will affect the same European site, should all the options be implemented concurrently. For the adaptive strategy, the assessment has identified two European sites that may be affected in-combination with the implementation of the planning strategy: the Stour and Orwell Estuaries SPA/Ramsar sites through the implementation of the Felixstowe desalination option and the Ipswich water reuse option, and The Wash SPA/Ramsar site and The Wash and North Norfolk Coast SAC through the implementation of both the Kings Lynn desalination and water reuse options.

The adaptive strategy identifies future solutions that may be needed if it is determined that further sustainability reductions are required in AMP8. They include large supply-side options, with long lead times and are unlikely to be delivered within one AMP cycle. Although unlikely that these options will be implemented at the same time as the options from the WRMP, it is possible that they will be implemented at AMP8. Therefore, an intra-plan in-combination assessment between the WRMP needs to be considered.

9.1.1 In-Combination Effects on The Wash SPA/Ramsar site and The Wash and North Norfolk Coast SAC

The Kings Lynn desalination and water reuse options have been identified with potential effects on The Wash. The identified adverse effects are as a result of (1) temporary construction impacts relating to pollution events and subsequent knock-on degradation of habitats and disturbance during construction resulting in adverse effects on water quality and, (2) operational impacts that may cause increased salinity due to the discharge of brine.

It is reasonably assumed that the impacts identified during construction can be mitigated fully and will therefore result in no residual effects, either alone or in-combination from both options. The unknown effect of increased salinity in the Wash due to brine discharge is restricted to the implementation of the desalination option only, therefore in-combination effects on Wash as a result of implementation of the WRMP are not considered likely at this time.

The identified potential adverse effects on the integrity of The Wash SPA/Ramsar site and The Wash and North Norfolk Coast SAC are as a result of toxic contamination during construction. Temporary construction impacts relate to pollution events resulting in adverse effects on water quality and operation impacts may cause non-toxic contamination due to changes in salinity.

9.1.2 In-Combination Effects on the Stour and Orwell Estuaries SPA/Ramsar site

The identified potential adverse effects on the integrity of the Stour and Orwell Estuaries SPA/Ramsar site are as a result of (1) temporary construction impacts relating to pollution events and subsequent knock-on degradation of habitats and disturbance during construction

resulting in adverse effects on water quality and, (2) operational impacts that may cause increased salinity due to the discharge of brine.

For the Felixstowe desalination and Ipswich water reuse options, the Task II: Appropriate Assessment has concluded that there would be no adverse effect due to construction-related impacts from either option subject to the provision of appropriate mitigation measures to avoid adverse effects. The mitigation advocated is also sufficient to ensure that, in-combination, there would be no adverse effects on the site. With mitigation in place, pollution-prevention would be ensured as far as is reasonably possible, and the zones of disturbance would not overlap to result in cumulative effects. The unknown of the effect of brine from the desalination option is restricted to the implementation of the Felixstowe option during operation only, therefore in-combination effects on the estuary is not considered likely.

9.2 Inter-Plan Effects

9.2.1 In-combination effects with other WRMPs

In-combination effects have the potential to arise where water resources are shared between neighbouring Water Companies, where any change in quantity or quality of these water resources could be reasonably foreseen to impact on a European site. Such a situation could occur if:

- Abstraction or discharge consents are proposed to exceed current consent limits; and
- New abstraction or discharges are proposed in an area with hydrological connection with shared water resources and European sites.

The neighbouring Water Companies to the Anglian Water region are Affinity Water, Cambridge Water, Essex and Suffolk Water, Severn Trent Water, Southern Water, Thames Water and Yorkshire Water. A review of draft WRMP from neighbouring Water Company's was undertaken, where possible, and the results are given in Table 44.

Table 44: HRA summary of neighbouring Water Company's draft WRMP 2019

Water Company	Summary of HRA findings
Affinity Water	Not available in the public domain. Unknown effects
Cambridge Water	The HRA of the draft WRMP19 has concluded that the preferred programme is compliant with the Habitats Directive, with no Likely Significant Effects on European sites.
Essex and Suffolk Water	The HRA of the draft WRMP 2019 identified potential Likely Significant Effects on the Alde-Ore Estuary and Geldeston Meadows only, where no residual effects were expected after the application of appropriate mitigation.
Severn Trent Water	The HRA concluded that the draft WRMP19 is compliant with the Habitats Directive, with no likely significant effects on European sites anticipated with the application of appropriate mitigation measures.
Southern Water	Southern Water draft WRMP 2019 HRA concluded potential effects on the following European sites, but no significant adverse effect identified individually in the option-level HRA: Arun Valley SAC; Emer Bog SAC; The New Forest SAC; River Itchen SAC; New Forest SPA & Ramsar; Solent & Southampton Water SPA & Ramsar; Lydden Temple Downs SAC; Parkgate Down SAC; Castle Hill SAC; Peter's Pit SAC; North Downs Woodlands SAC. None of these sites have the potential to be affected by Anglian Water's WRMP 2019
Thames Water	The HRA Screening assessment of the draft WRMP19 concluded that the options included within preferred programme, both individually and in-combination, are not likely to have any significant adverse effect on any European site, thereby meeting the "no likely significant effect (LSE)" on site integrity HRA test. No further HRA stages (i.e. Appropriate Assessment) were undertaken of the Thames Water draft WRMP19. A comprehensive mitigation strategy has been proposed for those

Water Company	Summary of HRA findings
	schemes included in the preferred programme where initial assessments highlighted the need for inclusion of mitigation measures as part of the scheme development.
Yorkshire Water	Not available in the public domain. Unknown effects.

From the review of neighbouring Water Company’s draft WRMP 2019, no European sites have been identified with the potential to be affected in-combination with the Anglian Water WRMP. For the Water Company’s where HRA assessments were not available (i.e. Affinity Water and Yorkshire Water) an assessment of in-combination effects has not been possible at this time. However, it is considered reasonable that options implemented as a result of Yorkshire Water’s WRMPs could result in adverse impacts on The Wash. For the Stour and Orwell estuaries, it is possible that Affinity Water propose options which are in hydrology continuity with this site; thus, the potential for in-combination effects remains. It is assumed, however, that any potential significant effects on European sites due to individual options, or in-combination effects will be avoided as far as reasonably possible, and ultimately no options that will result in residual effects (either alone or in-combination) will be implemented as part of the WRMP plans for either Water Company..

For the WRMP, It should be noted that neighbouring Water Company’s final WRMPs are at the same drafting stage as this WRMP, therefore a comprehensive review of in-combination effects is not feasible at this time. Therefore, an exercise was conducted for inclusion in this report to identify which of the proposed options of WRMP are located within 20 km of neighbouring Water Company regions. Table 46 below summarises the key findings of this study.

Table 45: Options within 20km of a neighbouring Water Company’s boundary with potential for inter-plan cumulative effects

Code	Plan	Option Name	Neighbouring water company	Distance to boundary
ESU1	Both	Felixstowe Desalination	Affinity Water	5 km
SEX2	LCP	Ardleigh Reservoir Extension	Affinity Water	5 km
CLN11a	LCP	South Humber Bank RZ to Central Lincolnshire RZ Transfer (10MI/d)	Southern Trent Water	20 km
CLN13a	BVP	South Humber Bank RZ to Central Lincolnshire RZ Transfer (31MI/d)	Southern Trent Water	20 km
CLN14	Both	South Humber Bank RZ to Central Lincolnshire RZ Transfer (6MI/d)	Southern Trent Water	20 km
CLN15	Both	South Humber Bank RZ to Central Lincolnshire RZ Transfer (Existing)	Southern Trent Water	20 km
CLN16	Both	South Humber Bank RZ to Central Lincolnshire RZ Transfer	Southern Trent Water	15 km
SLN6	Both	Central Lincolnshire RZ to South Lincolnshire RZ Transfer (63MI/d)	Southern Trent Water	10 km
RTN27	Both	South Lincolnshire RZ to Ruthamford North RZ Transfer (67MI/d)	Southern Trent Water	5 km
NTM1	Both	Central Lincolnshire RZ to Nottinghamshire RZ Transfer	Southern Trent Water	5 km
SHB2	BVP	Pyewipe Water Reuse for Non-Potable Use	Southern Trent Water	N/A
HPB1	Both	Norwich & the Broads RZ to Happisburgh RZ Transfer	Essex & Suffolk Water	5 km

The options identified above have the potential to contribute to cumulative effects on European designated sites if they are in direct hydrological connectivity or proximity with options included in the WRMP of neighbouring Water Companies. Ideally, more information would be available

about options included in neighbouring water company WRMPs to inform a comprehensive assessment of cumulative effects. Unfortunately, that information will not be made available until after the publication of this report. However, all options will be re-assessed in a project-level HRA prior to their implementation, by which point the necessary information should be available with which to make the in-combination assessment.

In addition to the above, several other transfer options were also identified as being within 20 km of the company boundaries. As most of these options will utilise existing abstractions and the resources are not shared between companies, the cumulative effects are likely to be negligible.

9.2.2 Anglian Water Drought Plan 2019

The WRMP will also have direct links to other Anglian Water plans such as the Drought Plan (DP) and other water company's plans. The WRMP will interact with and support the emerging Anglian Water DP 2019. The DP looks at demand side management actions and supply side management actions for ensuring water supply during drought conditions. Demand management options in the DP such as meter optants and leakage reduction are also contained in the WRMP but for the DP, meter optants, for example, would be focussed in areas at most risk of impact of drought, and leakage reduction works would be increased during periods of potential or actual drought. The DP also includes supply side schemes such as desalination and water reuse, however, specific details in terms of locations are not defined.

Eight supply side schemes that would potentially require a drought permit are defined in Anglian Water's DP 2019. These mainly include proposals to increase current abstraction limits (such as temporary lowering of Hands-Off or Mean Residual Flows) to allow Anglian Water to take more of its licensed abstraction allowances during low-flow periods. The eight options have been screened by Mott MacDonald for their potential to result in adverse effects on European sites (Mott MacDonald unpublished report, expected September 2018). Only one of the options has been identified with having potential LSE. Specifically, potential deterioration in water quality through increased ammonia and orthophosphate was identified in the Ouse Washes through implementation of a drought permit on the River Great Ouse. The WRMP in-combination assessment should be updated with the development of the final DP.

Potential adverse effects on the Ouse Washes SPA/Ramsar site/SAC have also been identified through the implementation of the Fenland reservoir option in the adaptive strategy of WRMP 2019. Adverse effects identified are through potential water pollution issues in the Washes during construction phase only. It can be reasonably assumed that appropriate mitigation can be applied to these options (both WRMP and DP) to ensure no deterioration of water quality occurs, and ultimately these options will only be implemented at a project-level with mitigation in place to avoid such impacts on water quality. Therefore, no in-combination effects of WRMP with the DP are reasonably foreseeable at this stage.

Anglian River Basin Flood Risk Management Plan 2015 – 2021 (Environment Agency) The Flood Risk Management Plan (FRMP) for the Anglian River Basin District (RBD) provides an overview of the range of flood risks from different sources across the 11 catchments of the RBD and more specifically from local flood sources in the South Essex Flood Risk Area (FRA). The main conclusion from the HRA assessment was a determination to screen out measures that would not have physical effects on any European sites. For new and existing plans, the HRA considered the range of mitigation options that may be applicable and concluded that the measures were expected to be able to be avoided or mitigated as part of their development as local actions. It was therefore concluded that at the plan level there is sufficient scope for ensuring no likely significant effects during its implementation. The HRA also considered the

potential for in-combination effects with Local Plans, WRMPs, River Basin Management Plans and Marine Plans and were assessed as not resulting in cumulative effects on the FRMP.

The in-combination assessment does not remove the need for HRA at a subsequent level, i.e. lower tier project-level assessments, but at the strategic level is unlikely to result in in-combination effects of the Anglian Water WRMP.

9.2.3 Water Resources East

The WRMP 2019 covers the 25-year period from 2020 to 2045. Through Water Resources East (WRE), Anglian Water has also carried out longer term planning (beyond 2045) at the regional level. The WRE Programme is a long-term water resources strategy to 2100. The purpose of the WRE programme is to develop a reliable, affordable, and sustainable system of water supply in the East of England which is resilient to the effects of climate change, growth, and multi-season drought. The WRMP is aligned with the WRE preliminary regional strategy as outlined below. The WRE strategy includes:

- New reservoir storage capacity, capturing high winter flows – the WRMP provides the flexibility to deliver new reservoir storage capacity in the region in the future, and distribute resources across the region.
- Treated water imports – Anglian Water has considered import options in their decision-making approach and will continue to assess these working towards WRMP 2024.
- A network of strategic transfers, to share resources between companies and across sectors – the WRMP delivers a network of strategic transfers across the region.
- Desalination and water reuse at key locations on the east coast – the WRMP includes water reuse in AMP7 and the development of desalination in AMP9.

Anglian Water will continue to assess these options working towards WRMP 2024 and all options will be subject to a HRA assessment at both a strategic and project level (pre-implementation) that includes potential effects on European sites in-combination with WRMP development. Therefore, no in-combination effects of WRMP with WRE are considered further in this assessment.

9.2.4 Environment Agency National Drought Plan

The potential for in-combination effects of this plan with the Environment Agency's National Drought Action Plan has been assessed. No in-combination effects on European sites are anticipated.

9.2.5 River Basin Management Plans 2015

Anglian River Basin District/Humber River Basin District/South East River Basin District

RBMPs are assessed at the strategic level plan stage. The detail of precisely where and how the programme of measures will be implemented has not yet been developed, and the range of potential control and mitigation techniques that could be applied allows confidence that the measures could go ahead without harm to European sites, subject to more detailed scrutiny of mitigation options at the lower tier plan or project level.

The HRAs of the River Basin Management Plans have concluded that none of the measures identified in these plans would have any significant adverse effects on any European site, as the locations where the measures would be implemented are not constrained. The measures would also be implemented in such a way that there would be no in-combination effects within the RBMPs.

This conclusion is primarily drawn because the RBMP does not constrain where or how the measures are implemented, and the process for deferring HRA to lower tier plan or project level, where necessary, will provide for a range of mitigation options to be pursued at the lower tier plan or project level.

Therefore, no cumulative impacts from RBMPs in-combination with Anglian Water WRMP have been identified, and no cumulative LSEs are anticipated.

9.3 Inter-Project Effects

It has not been possible to predict a definitive list of existing planning applications within the Anglian region to review possible in-combination effects. The timescales for construction of the options within WRMP are such that generating a list at this stage would be of little value. Since the WRMP has been developed with reference to Local Plans, the combined effect of any minor developments on water demand has been accounted for in WRMP projections. Furthermore, no major projects are known in the period of WRMP in the Anglian region.

Therefore, no in-combination effects with other projects are anticipated at this stage. It is possible that scheme-specific effects from future planning applications may result in cumulative effects on European sites, but it is reasonably assumed that these future projects will be thoroughly assessed at the project-level HRA, prior to implementation of the option.

10 Summary of WRMP HRA Task II: Appropriate Assessment

10.1 Summary of the Task II: Appropriate Assessment

Following the Task I: Screening assessment, five options included in Anglian Waters WRMP were assessed as having Likely Significant Effects on European sites. For the WRMP the following option was included:

- ESU1 Felixstowe Desalination

As well as the above option, the adaptive strategy included four other options where Likely Significant Effects were identified:

- ESU2 Ipswich Water Reuse
- NFN1 Kings Lynn Desalination
- NFN2 Kings Lynn Water Reuse
- NFN3 Fenland Reservoir

These five options were subject to a Task II: Appropriate Assessment, which forms the subject of this report.

For the two desalination options (ESU1 - Felixstowe and NFN1 – Kings Lynn), the level of detail of the plan does not allow detailed consideration of effects on individual European sites and it has been concluded that the effects of the impacts identified during operation (i.e. potential increase in salinity as a result of brine discharge) will need to be explored further in order to demonstrate that the integrity of European sites will not be significantly adversely affected. However, at this strategic level, the assessment undertaken still allows confidence that the option could go ahead without harm to European sites, subject to more detailed scrutiny of mitigation options at the lower tier plan or project level and potential mitigation for this adverse effect has been recommended regardless. It is reasonably assumed that as these options are further developed, and the specifics of brine discharge within the options is fully understood; assessment at lower tier plan or project level HRA will result in appropriate mitigation being developed to ensure desalination options result in no significant adverse effects on the integrity of the European sites identified.

For the remaining four options identified in the Task I: Screening Assessment (SHB2, ESU2, NFN2 and NFN3), appropriate mitigation measures have been identified in the Task II: Appropriate Assessment to ensure that the integrity of the European sites identified will not be adversely affected as a result of construction or operation.

The results of the HRA Task II: Appropriate Assessment for the WRMP options is given in Table 47.

Table 46: WRMP 2019 options HRA summary

Option ref.	Option name	WRZ	Likelihood of adverse effects on the integrity of European sites?
ESU1	Felixstowe Desalination	East Suffolk	Unknown at this stage There is a likelihood for adverse effects on the Stour and Orwell Estuaries SPA/Ramsar site and Deben Estuary SPA/Ramsar site during construction and operation of the option.

Option ref.	Option name	WRZ	Likelihood of adverse effects on the integrity of European sites?
			<p>Temporary construction impacts relate to pollution events resulting in adverse effects on water quality. It is assumed however that appropriate measures can be put in place to ensure there is no residual effects on the integrity of the European sites</p> <p>Operation impacts may cause non-toxic contamination due to changes in salinity as a result of discharged brine. The effects of increased salinity due to brine discharge will need to be explored further as this option is developed in order to demonstrate that the integrity of European sites will not be significantly adversely affected. It is reasonably assumed that assessment at lower tier plan or project level HRA will result in appropriate mitigation being developed to ensure desalination options result in no significant adverse effects on the integrity of the European sites identified.</p>
SHB2	Pyewipe Water Reuse for non-potable use	South Humber Bank	<p>No</p> <p>Potential for temporary and permanent adverse effects on the Humber Estuary SPA/Ramsar site/SAC during construction and operation of the option have been identified. These impacts relate to possible disturbance to qualifying bird species of the SPA/Ramsar site during construction, pollution events resulting in adverse effects on water quality and entering the Humber Estuary and air pollution affecting aquatic habitats, bird and fish species of the SPA/Ramsar site/SAC.</p> <p>It is assumed that appropriate mitigation measures can be put in place to ensure there is no residual effects on the integrity of the European sites.</p>
ESU2	Ipswich Water Reuse	East Suffolk	<p>No</p> <p>Potential for temporary and permanent adverse effects on the Stour and Orwell Estuaries SPA/Ramsar site during construction of the option have been identified. These impacts relate to potential degradation of habitats supporting the qualifying bird species of the SPA/Ramsar site and qualifying plants and invertebrates of the Ramsar site, possible disturbance to qualifying bird species of the SPA/Ramsar site, and pollution events resulting in adverse effects on water quality and entering the Orwell Estuary affecting bird, plant and invertebrate species of the SPA/Ramsar site.</p> <p>It is assumed however that appropriate mitigation measures can be put in place to ensure there is no residual effects on the integrity of the European sites.</p>
NFN1	Kings Lynn Desalination	North Fenland	<p>Unknown at this stage</p> <p>There is a likelihood for adverse effects on the Wash SPA/Ramsar site/SAC during the construction and operation of the option.</p> <p>Temporary construction impacts relate to pollution events resulting in potential adverse effects on water. It is assumed however that appropriate measures can be put in place to ensure there is no residual effects on the integrity of the European sites</p> <p>Operational impacts relate to non-toxic contamination due to changes in salinity as a result of brine discharge. The effects of increased salinity due to brine discharge will need to be explored further as this option is developed in order to demonstrate that the integrity of European sites will not be significantly adversely affected. It is reasonably assumed that assessment at lower tier plan or project level HRA will result in appropriate mitigation being developed to ensure desalination options result in no significant adverse effects on the integrity of the European sites identified.</p>

Option ref.	Option name	WRZ	Likelihood of adverse effects on the integrity of European sites?
NFN2	Kings Lynn Water Reuse	North Fenland	<p>No</p> <p>The likelihood for adverse effects on the Wash SPA/Ramsar site/SAC during the construction of the option have been identified, which relate to pollution events resulting in potential adverse effects on water quality.</p> <p>It is assumed however that appropriate mitigation measures can be put in place to ensure there is no residual effects on the integrity of the European sites.</p>
NFN3	Fenland Reservoir	North Fenland	<p>No</p> <p>The likelihood for temporary adverse effects on the Ouse Washes SPA/Ramsar site/SAC and Breckland SAC during construction of this option has been identified.</p> <p>These impacts relate to water pollution in the Ouse Washes and noise/visual presence/light disturbance on Breckland.</p> <p>It has been demonstrated that appropriate mitigation measures can be put in place to ensure there is no residual effects on the integrity of the European sites.</p>

10.2 Summary of In-Combination Effects Assessment

The in-combination assessment shows that none of the options included in the WRMP have the potential to act in-combination to result in residual effects on European sites.

For the adaptive strategy, the assessment has identified two European sites that may be affected in-combination with the implementation of the planning strategy: the Stour and Orwell Estuaries SPA/Ramsar sites through the implementation of the Felixstowe desalination option and the Ipswich water reuse option, and The Wash SPA/Ramsar site and The Wash and North Norfolk Coast SAC through the implementation of both the Kings Lynn desalination and water reuse options. It is reasonably assumed that the impacts identified during construction can be mitigated fully and will therefore result in no residual effects, either alone or in-combination from both options. The unknown of the effect of brine from the desalination options is restricted to the implementation of the Felixstowe and Kings Lynne desalination options only, therefore intra-plan in-combination effects on the European sites is not considered likely.

The potential for Anglian Waters WRMP to act in-combination with neighbouring Water Company's WRMPs was preliminary assessed, based on assessments of options in draft WRMPs where available, and acknowledgement of options in WRMP which are within 20km of a neighbouring Water Company's boundary. No European sites have been identified with the potential to be affected in-combination with the Anglian Water WRMP and the draft WRMPs, but it is noted that the final WRMPs may include options that will need to be relooked at, at the project-level or lower tier HRA.

WRMP will interact with and support the emerging Anglian Water Drought Plan 2019. Potential in-combination effects on the Ouse Washes SPA/Ramsar site/SAC have been identified through the implementation of the Fenland reservoir option in the adaptive strategy of WRMP. It can be reasonably assumed that appropriate mitigation can be applied to these options (both WRMP and Drought Plan) to ensure no deterioration of water quality occurs, and ultimately these options will only be implemented at a project-level with mitigation in place to avoid such impacts on water quality. Therefore, no in-combination effects of WRMP with the Drought Plan are reasonably foreseeable at this stage.

In-combination effects are also considered unlikely between WRMP and the following plans or projects:

- Anglian River Basin Flood Risk Management Plan
- Water Resources East (WRE)
- The Environment Agency's National Drought Action Plan;
- Relevant River Basin Management Plans

Finally, no in-combination effects with other projects are anticipated at this stage. It is possible that scheme-specific effects from future planning applications may result in cumulative effects on European sites, but it is reasonably assumed that these future projects will be thoroughly assessed at lower tier project-level HRA, prior to implementation of the option.

10.3 Overall Conclusion of WRMP HRA

Acceptance that Anglian Waters WRMP is consistent with the Habitats Regulations is on the basis of the level of detail available at the time of assessment. As the options are further developed at a project level, and the specifics of their scope and scale are known, this may identify additional effects on European sites that have not been assessed here or were not appropriate to consider at the spatial scale of a strategic plan.

This conclusion does not therefore remove the need for lower tier project-level HRA assessments of the options included in WRMP, or future plans, projects, or permissions which may act in-combination with WRMP and it is important to note that inclusion of options within WRMP should not have any influence on the lower tier or project level HRA conclusions.

Any HRA at the lower tier for which adverse effects on site integrity cannot be ruled out, and cannot be mitigated, must consider the merits of the individual project to determine whether there are imperative reasons of overriding public interest for its implementation, otherwise it is assumed that these options will not be implemented as part of WRMP.

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Appendices

A.	Description of European Site Qualifying Features in the Anglian Region	127
B.	Maps of Options and European Sites	128
C.	Removed Options Assessments	129
D.	Consultation Log	130

A. Description of European Site Qualifying Features in the Anglian Region

A literature review of the sensitivity of the qualifying features of all the European sites included in this Task II: Appropriate Assessment has been undertaken and is summarised in this Appendix A.

B. Maps of Options and European Sites

Maps showing the proposed infrastructure locations of the options included in this Task II: Appropriate Assessment and the associated European designated sites are given in Appendix B.

C. Removed Options Assessments

A Habitats Regulations Assessment (HRA) Task II: Appropriate Assessment (AA) was undertaken of the options included in the draft WRMP. Not all of these options were included in WRMP. Options not included in the WRMP were removed from the final submitted HRA Task II: AA Report (Mott MacDonald, March 2018). This document presents the HRA Task II: AA raw data assessments for the options not included in the final report.

D. Consultation Log

The draft WRMP HRA was issued for formal public consultation from March to May 2018. The responses received are documented in this appendix along with how the comments have been addressed in developing the WRMP HRA documents.

